Aviation Week

Including Space Technology

August 17, 1959

Simulators Train Pilots to Control Mercury Capsule

PanAm 707 Jet, Aeroflot Tu-114 Meet at Idlewild

Reaching for the Moon, Mr Designer?

Here's a tip... Millions of Kaylock® nuts ago, a new aircraft fastener made its bow... the Kaylock H20, first lightweight, high tensile, all-metal, self-locking nut.

Its significant improvement over then-existing fasteners – lighter weight, greater strength, smaller envelope – won immediate acceptance by airframe weight engineers and designers.

Today, with a premium on weight and space savings in aero-space vehicles and engines, design engineers depend more than ever on Kaylock nuts. So here's a tip...

If you're reaching for the moon, Mr. Designer, reach for your up-to-the-minute Kaylock catalogs first. Chances are, *your* "brainchild" will *get there sooner.*

Fastener with a past – that's the Kaylock H20. A favorite callout of design engineers for the past 3 years, the H20 was the first high tensile, all-metal nut using the elliptical self-locking principle for which Kaylock nuts are famous. "Vital statistics" include:

Service Temperature: 550°F
Tensile Strength: 180,000PSI
Material: Alloy Steel

Ready to Help – Here are a few of the Kaylock external wrenching nuts built to meet rigid requirements in weight and space reduction.

H14 — Service Temperature: 550°F, Tensile Strength: 160,000PSI, Material: Carbon Steel

H23 — Service Temperature: 550°F, Tensile Strength: 180,000PSI, Material: Alloy Steel

H24 — Service Temperature: 550°F, Tensile Strength: 220,000PSI, Material: Alloy Steel

H41 — Service Temperature: 900°F, Tensile Strength: 125,000PSI, Material: A286 CRES

H33 — Service Temperature: 1200°F, Tensile Strength: 160,000PSI, Material: A286 CRES

H19083 — Service Temperature: 1400°F, Tensile Strength: 160,000PSI, Material: M252 CRES

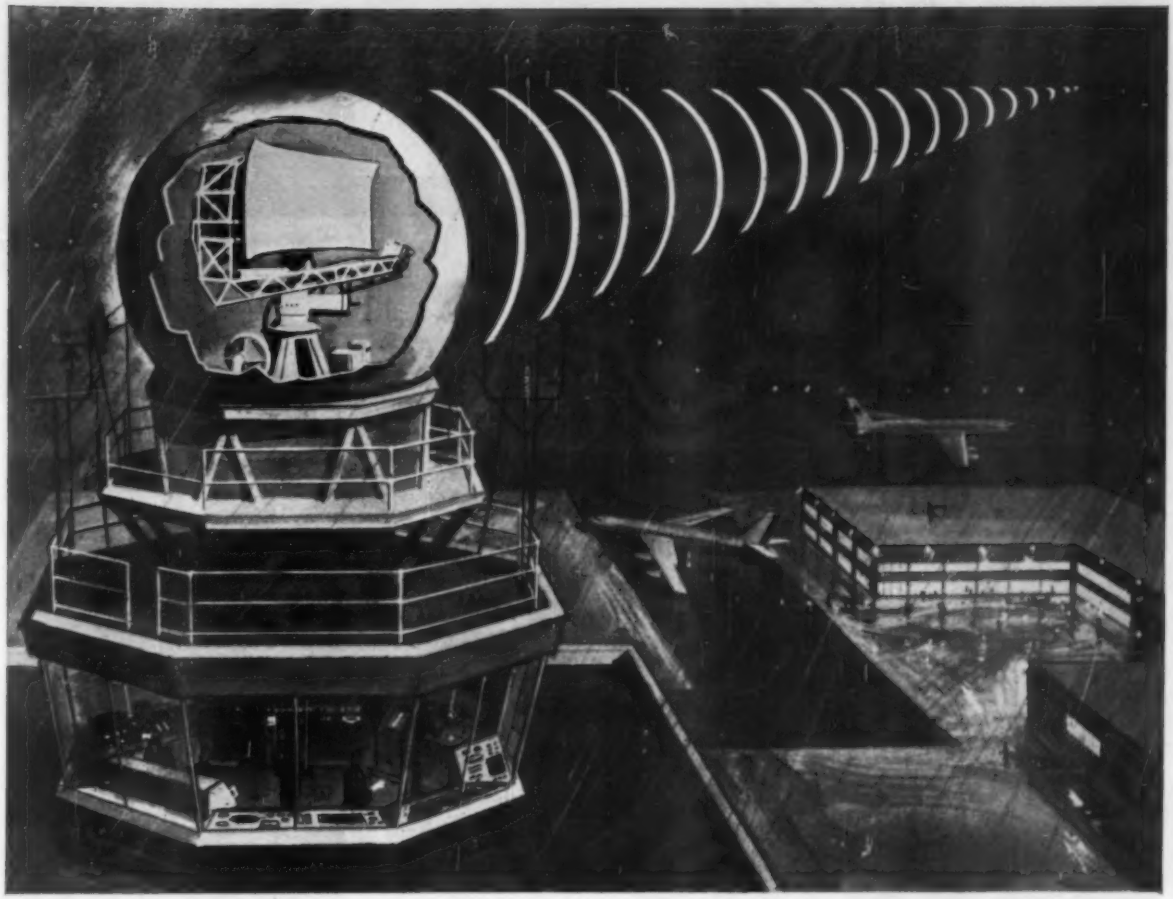
H10 — Service Temperature: 550°F, Tensile Strength: 125,000PSI, Material: Carbon Steel

H31 — Service Temperature: 900°F, Tensile Strength: 125,000PSI, Material: A286 CRES

Kaylock ALL METAL SELF-LOCKING NUTS

TRADE MARK

KAYNAR MFG. CO., INC.– KAYLOCK DIVISION • *World's largest and oldest manufacturer of lightweight, all-metal, self-locking nuts.*
Home office and plant: Write Box 2001, Terminal Annex, Los Angeles 54, California
Branch offices, warehouses and representatives in Wichita, Kansas; New York, N. Y.; Atlanta, Georgia. Canadian Distributor: Abercorn Aero, Ltd., Montreal, Quebec.



HOW TO KEEP AN EYE ON RUNWAYS EVEN WHEN THERE'S "NO VISIBILITY"!

In recent years, the job of the airport traffic controller has become increasingly difficult. Runways are longer. Flights are more frequent. And planes are landing with one-mile visibility—often less!

Now—an Electronic "Eye" has been perfected that gives the controller a *visual report* of ground traffic even when there is "no visibility." Developed by the Airborne Instruments Laboratory—a division of Cutler-Hammer, Inc.—this Airport Surface Detection Equipment (ASDE) provides a high resolution radar picture of all aircraft, ground vehicles, and hangars up to a 4 mile range of the control tower. This equipment is so precise that two men—standing at arm's length from each other 1500 feet from the tower—will appear as two clearly defined objects on the ASDE scope.

Because of long and varied experience in radar engineering and radome design, Goodyear Aircraft is supplying the 4 x 12 foot double curved reflector dish, the pedestal, and most of the major mechanical parts of the antenna system.

The unprecedented accuracy of this equipment is enhanced by the dependability of the antenna structure and rotating equipment developed by Goodyear Aircraft. This invaluable background of experience is available to you now—ready to assume full responsibility for the most advanced radar systems of the future. Write Goodyear Aircraft Corporation, Dept. 916FH, Akron 15, Ohio.

RADAR STRUCTURES AND RADOMES —A PRIME CAPABILITY OF **GOODYEAR AIRCRAFT**

Plants in Akron, Ohio, and Litchfield Park, Arizona

Branch offices, warehouses and representatives in Wichita, Kansas; New York, N. Y.; Atlanta, Georgia. Canadian Distributor: Abercorn Aero, Ltd., Montreal, Quebec.

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AMERICA'S NEWEST COMBINATION OF EXPERIENCED INDUSTRIES

Poly Industries combines six experienced divisions and subsidiaries to offer a new range of products and services . . . for the present and future.

Engineering, design and production of fluid dynamic, power components and ground support equipment—for flight, electronics, and industry—are united in this new approach. This flexible new combination of six industries simplifies the complex buying function and project coordination through a single integrated national field and engineering staff. We invite your inquiry.

Write for New Capabilities Brochure...

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Exceptional employment opportunities for qualified engineers experienced in fluid dynamics and power components.

AVIATION CALENDAR

Aug. 24-26—Gas Dynamic Symposium, American Rocket Society, Northwestern University, Evanston, Ill.

Aug. 24-26—Institute of the Aeronautical Sciences' National Specialists Meeting, a symposium on anti-submarine warfare, (classified), San Diego, Calif.

Aug. 24-27—Fourth Symposium on Ballistic Missiles and Space Technology, Los Angeles, Calif. Sponsors: USAF's BMD; Space Technology Laboratories, Inc.

Aug. 27-28—International Commonwealth Spaceflight Symposium, Church House, Westminster, London, England.

Aug. 31-Sept. 2—Annual Army-Navy Instrumentation Program (ANIP) Symposium and Industry Briefing, Statler Hilton Hotel, Dallas, Tex.

Aug. 31-Sept 3—Conference on Stratospheric Meteorology, American Meteorological Society, Curtis Hotel, Minneapolis, Minn.

Aug. 31-Sept 5—10th Annual Congress, International Astronautical Federation, Church House, Westminster, London.

Sept. 1-2—Conference on physical chemistry in aerodynamic and space flight, University of Pennsylvania, Philadelphia, Pa. Sponsors: Air Force Office of Scientific Research and General Electric Co.'s Missile and Space Vehicle Dept.

Sept. 2-4—1959 Cryogenic Engineering Conference, University of California, Berkeley, Calif.

Sept. 3-6—National Convention and Aerospace Panorama, Air Force Assn., Exhibition Hall, Miami Beach, Fla.

Sept. 7-13—1959 Farnborough Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, Eng.

Sept. 9-11—Sixth Midwestern Conference on Fluid and Solid Mechanics, University of Texas, Austin, Tex. Sponsors: AFOSR/Directorate of Aeronautical Sciences; Office of Naval Research; National Science Foundation.

(*Continued on page 6*)

AVIATION WEEK Including Space Technology

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Vol. 71, No. 7

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Let's not kid ourselves — *nothing* is perfect. But we think you'll agree that the x-band radar antenna shown is about as close as you'll ever get. For example, reliability has been *Ingeneered* into the scanner of this knee-high package simply by keeping the number of moving parts to a minimum: *one*.

That isn't the whole story, of course. We could talk about things like modular packages for az-el drives, how the feed exhibits circular symmetry to r-f, how we get high-speed nutation by rotation and on and on . . . But we figure your requirements are probably different than the next fellow's anyway, so why don't you write us if you want all the specs? 15330 Oxnard St., Van Nuys.

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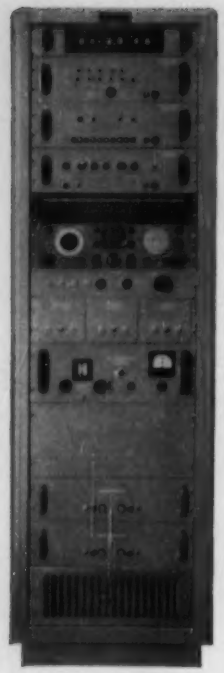
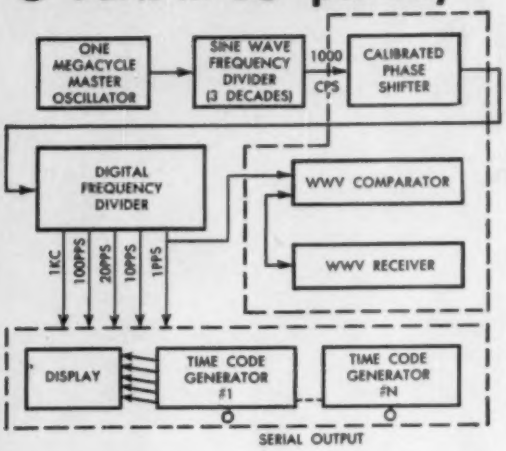


Hermes Range Time Generator
Model 207

Missile Range
TIMING SYSTEM
with Stability of
5 Parts in 10^{10} per Day



This System is composed of a Precision Frequency Time Base Oscillator with a stability better than 5 parts in 10^{10} per day; a WWV Receiver with appropriate circuitry for synchronizing the System with WWV; Digital Timing Generators providing timing signals that can be recorded on magnetic tape, oscillographs, plotting boards, phototheodolites, etc.; and line driving equipments for time distribution.

The Hermes System is at present being used for range time generation at some of the country's major missile test ranges.

Write for Range Timing Bulletin PTS

FEATURES

- **TIME BASE FREQUENCY STABILITY** 5 parts in 10^{10} per day (max. drift of 22 μ sec.)
- **SYNCHRONIZATION** to WWV with transmission propagation compensation
- **TIME CODE FORMAT** Choice of any of the major time codes such as AFMTC, AFFTC, NOMTC, and others
- **OUTPUTS PROVIDED** for recording time on tape recorders, oscillographs, plotting boards, phototheodolites, etc.
- **TIME** is displayed in hours, minutes, and seconds through use of horizontally mounted Arabic indicators.
- **SINE WAVE FREQUENCIES** available at 1000 Kc, 100 Kc, 10 Kc, and 1 Kc, and pulse rates of 1000 pps, 100 pps, 10 pps, 1 pps, and 1 pp 15 sec.

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Booth Nos.
2821 and 2823

The new name for HYCON EASTERN, INC. is

Hermes Electronics Co.

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AVIATION CALENDAR

(Continued from page 5)

Sept. 14-15—Display of USAF Ground Support Equipment for Manned and Unmanned Aerospace Vehicles, Society of Automotive Engineers, Milwaukee Arena, Milwaukee, Wis.

Sept. 14-16—14th Midwest Quality Control Conference, American Society for Quality Control, Sheraton Hotel, French Lick, Ind.

Sept. 16-17—Western Regional Meeting on Frontiers of Science and Engineering, Institute of the Aeronautical Sciences, Los Angeles, Calif.

Sept. 17-18—Conference on Effects of Nuclear Radiation on Semiconductors, Western Union Auditorium, New York, N. Y. Sponsor: Army Signal Corps.

Sept. 20-25—14th Annual Conference and Exhibit, Instrument Society of America, Chicago, Amphitheater, Chicago, Ill.

Sept. 21-22—Conference on Planning and Designing of Urban Helicopter Facilities, Institute of Aeronautical Sciences Bldg., Los Angeles, Calif. Sponsor: Los Angeles Chamber of Commerce.

Sept. 21-22—Eighth Annual Meeting, Standards Engineering Society, on Investment in Survival, Somerset Hotel, Boston, Mass.

Sept. 23-24—Engine and Operations Symposium, Airwork Corp., Millville, N. J.

Sept. 28-30—1959 National Symposium on Telemetering, Civic Auditorium and Whitcomb Hotel, San Francisco, Calif. Sponsor: Institute of Radio Engineers' Professional Group on Space Electronics & Telemetry.

Sept. 30-Oct. 2—13th Annual Meeting, Southeastern Airport Managers' Assn., Washington Duke Hotel, Durham, N. C.

Oct. 5-7—Seventh Anglo-American Aeronautics Conference, Institute of the Aeronautical Sciences, Hotel Astor, New York, N. Y.

Oct. 5-10—National Aeronautic Meeting, Society of Automotive Engineers, the Ambassador, Los Angeles, Calif.

Oct. 6-8—12th Annual Meeting, National Business Aircraft Assn., Hotel Leamington, Minneapolis, Minn.

Oct. 6-9—International Symposium on High-Temperature Technology, Asilomar Conference Grounds, Monterey Peninsula, Calif. Sponsor: Stanford Research Institute.

Oct. 7-8—Second Advanced Propulsion Systems Symposium, New England Mutual Hall, Boston, Mass. Sponsors: Air Force Office of Scientific Research; Avco-Everett Research Laboratory.

Oct. 7-10—Fourth Annual National Meeting, Air Traffic Control Assn., Biltmore Hotel, Oklahoma City, Okla.

Oct. 8-10—Society of Experimental Test Pilots' Symposium on Pilot's Role in Space Exploration, Beverly Hilton Hotel, Beverly Hills, Calif. Third Annual Awards Banquet, Oct. 10.

Oct. 12-14—15th National Electronics Conference, Hotel Sherman, Chicago, Ill.

Oct. 12-16—15th Annual General Meeting of the International Air Transport Assn., Imperial Hotel, Tokyo, Japan.

Oct. 14-23—"William Tell II," Seventh World-Wide Interceptor Weapons Meet, Tyndall AFB, Panama City, Fla. Host: Air Defense Command.

Crosley Radar

And . . . . . .

America's defense

Soon the latest in ground radar from Crosley will stand watch along the distant approaches to the North American continent. Since 1955 Crosley's radar engineers have been at work—designing, perfecting, improving this important new radar unit.

Now the FPS-26 ground radar is ready for production, and Avco's Crosley Division has been named prime contractor by the U. S. Air Force.

The huge radar—so new that it is still classified—will be housed in a radome more than 50 feet in diameter. It will be mounted atop a reinforced concrete tower more than 70 feet high and will consist of more than 300,000 parts, including some 3500 tubes and diodes.

Handling the design and production of complex, challenging radars is "old hat" to Crosley, prime contractor of the famous MPS-16 height finder radar now widely used by the armed forces. Similarly, Crosley now is prime contractor to the Air Force for the radar-directed fire control system that puts a 50-caliber "stinger" in the tail of the B-52 bomber.

Radar is just one example of Crosley know-how in both engineering and production—*designing* the best possible performance into the product . . . *producing* it on schedule, and at a reasonable cost.

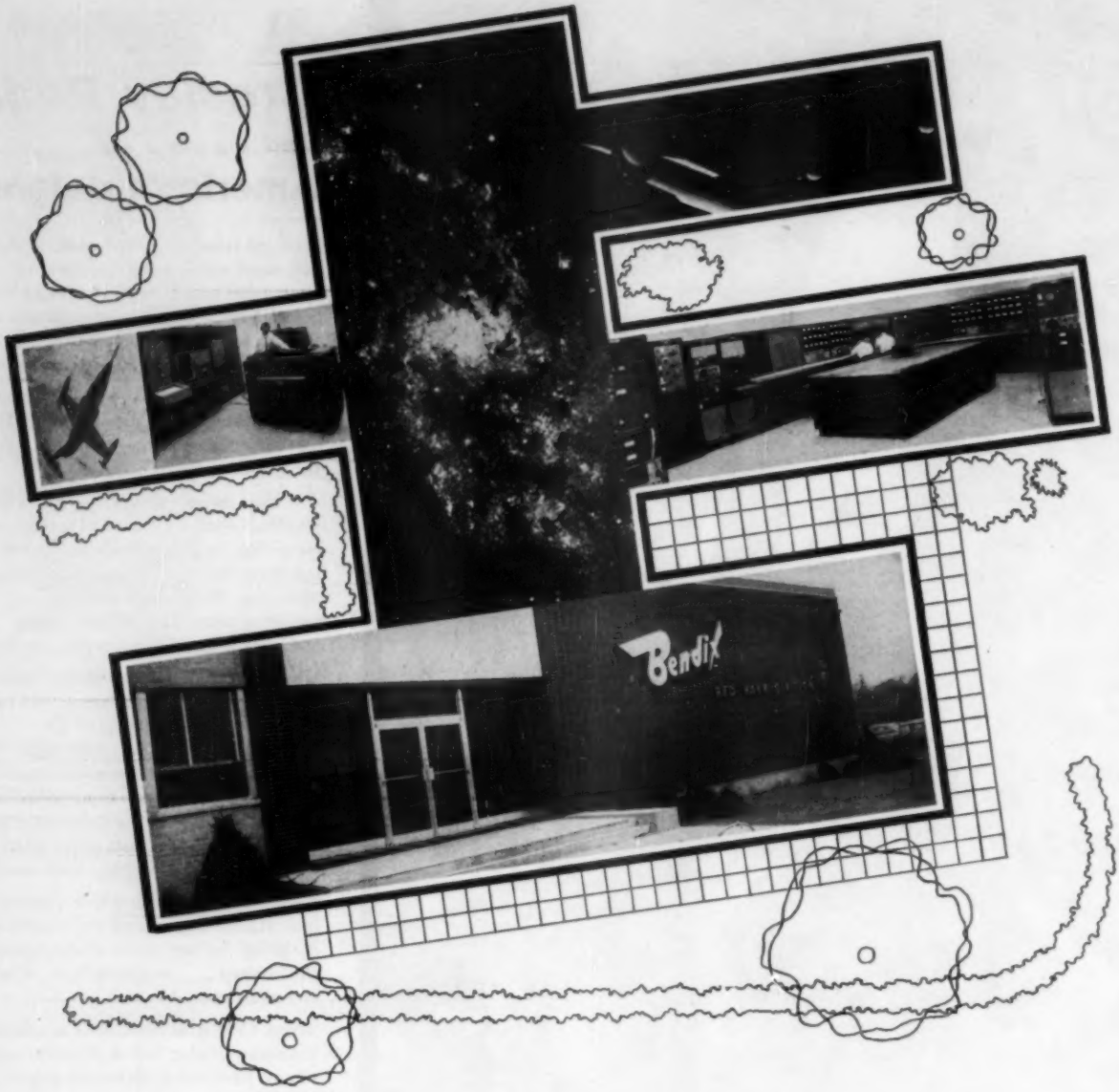
Today Crosley is recognized as a leader, not only in radar, but in communications, marine electronics, electronic ground support, infrared, fire control systems, air traffic control, ordnance and missile arming and fuzing.

For more information, write to: Vice President, Marketing-Defense Products, Crosley Division, Avco Corporation, 1329 Arlington Street, Cincinnati 25, Ohio.

Avco/Crosley

ENGINEERS:

Creative research and development engineers experienced in electronics, mechanics, weapons systems, and ordnance warheads are urged to investigate the wide range of opportunity at Crosley. Write to: Director—Technical and Scientific Personnel, Dept. W-89E, Avco/Crosley, 1329 Arlington Street, Cincinnati 25, Ohio.



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Bendix Red Bank's rapid growth since 1941 from a small maker of electrical devices to its present role as producer of a multitude of complex electrical and electronic systems is your added assurance that advanced engineering is a built-in Red Bank feature.

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Bendix
AVIATION CORPORATION

Ryan has built every production rocket motor for America's first operational guided missile – the Army's Corporal – for over five years.

It takes tremendous power to boost the 10-ton Corporal to Mach 3 flight speeds... to drop its atomic blast on a target 100 miles away. And this power must be controlled with pinpoint precision.

Ryan achieves this fine precision by forming, welding, and machining Corporal rocket motors to laboratory-like tolerances. Ryan has over twenty years' experience in this exacting type of work, which merges high-temperature metallurgy with manufacturing skills.

Designed by the Cal-Tech Jet Propulsion Laboratories, the Corporal motor is built by Ryan for the Firestone Tire and Rubber Company, prime contractors for the Corporal missile.

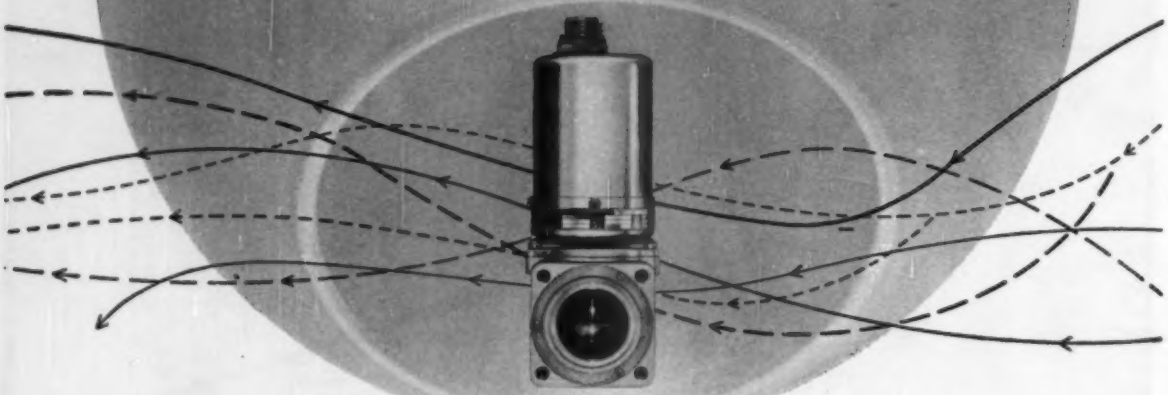
The Army relies on the Corporal's rocket motors for unerring performance – shot after shot. America's aircraft, engine, and missile manufacturers can rely on Ryan, too – for building complete propulsion systems ... for building single components for rocket motors, ramjets, or turbojet engines.

RYAN BUILDS BETTER

AIRCRAFT · POWER PLANTS · ELECTRONICS

Ryan Aeronautical Company, San Diego, Calif.

WHITTAKER SPHERICAL PLUG VALVES



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WHEN IT COMES TO SHIELDED WIRE

SLIDE on the ferrule

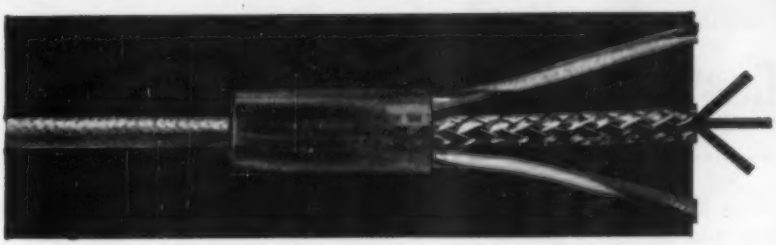
SLIP in the ground taps

CRIMP the three together

SNAP on the insulation

PRESTO!

the best insulated ferrule you can buy



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HYATT *HY-ROLL BEARINGS* FOR AIRCRAFT INDUSTRY

REAL TIME..
UNIVERSAL BASIS FOR
DATA CORRELATION

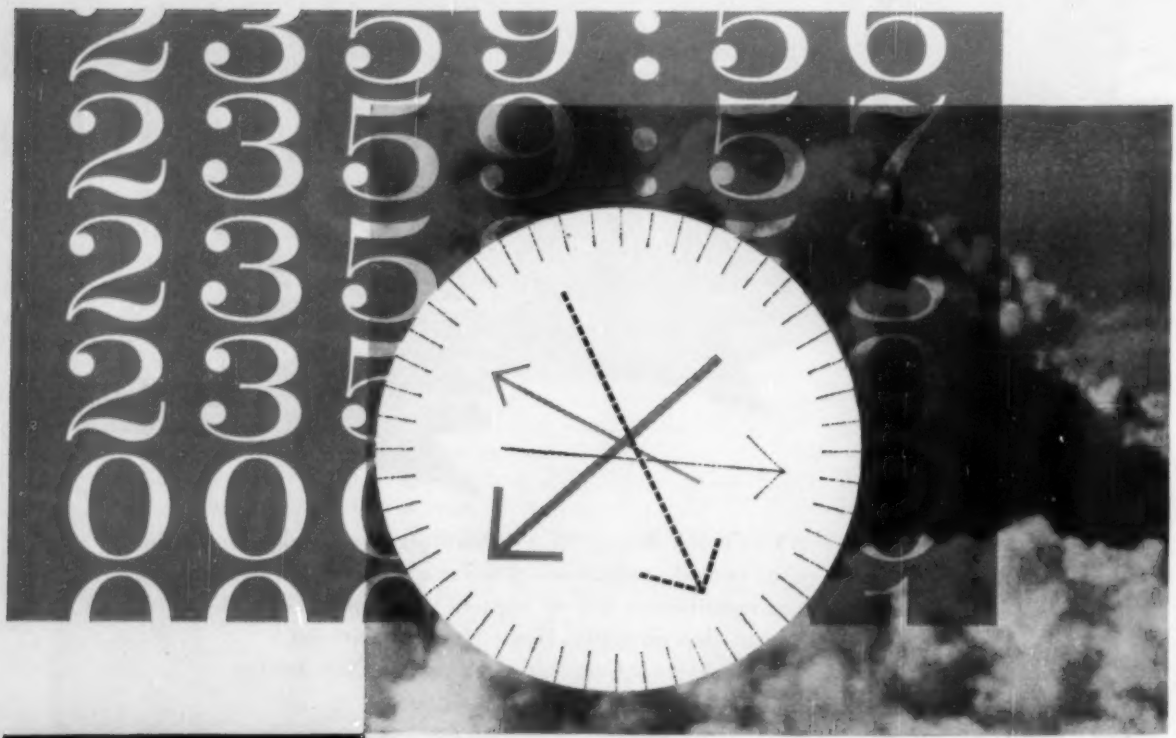
DIGITAL TIMING SYSTEM

Temco's Digital Timing System is a compact, accurate, airborne device capable of generating real time information for visual display at up to 21 remote indicators, for magnetic tape and graphic recordings, and as a source of coded digital time for master time transmission.

The system will automatically synchronize to a transmitted master time signal and correct for propogation delay time, insuring exact time event relationship of all remote systems. The additional capability to decode a recorded or transmitted signal makes the system complete in itself.

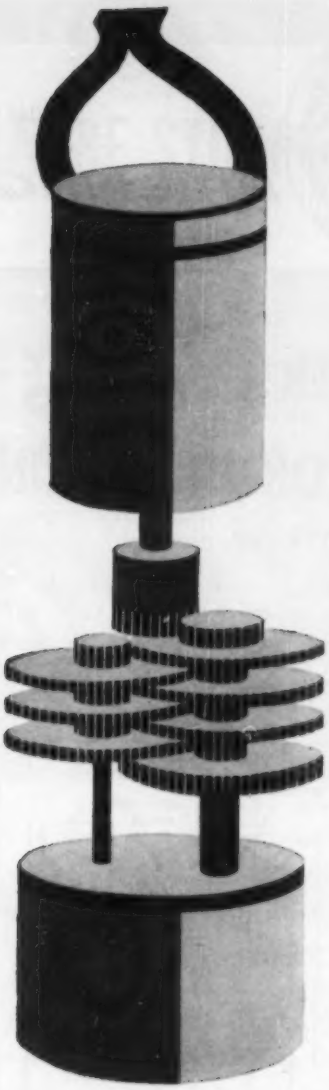
One of Temco's many proprietary products, the Model G-1033 Digital Timing System was developed and manufactured by Temco's Overhaul and Aerosystems Division assisted by Temco Electronics and is now in use on classified military programs.

Many excellent engineering and scientific positions are now open in this and other Temco programs. We invite your inquiry.



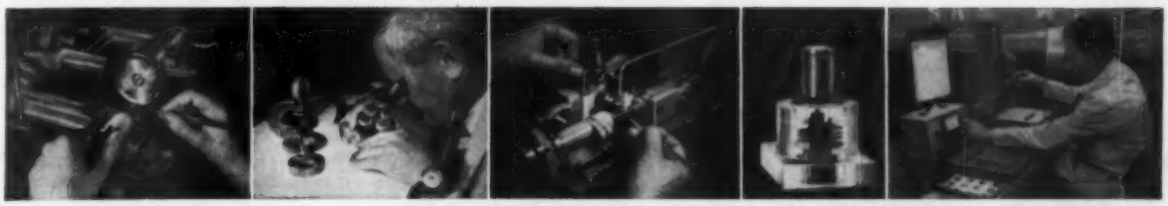
TEMCO OVERHAUL & AEROSYSTEMS

A Division of TEMCO AIRCRAFT CORPORATION • *P. O. Box 1056 Greenville, Texas*



36,000-to-1 gear reduction within one cubic inch... by Bulova

Bulova again accomplishes the unusual.



This dramatic miniature—like so many other Bulova "firsts"—came about as a matter of routine within a manufacturing assignment. This time missile "checkout" equipment profited by Bulova's job-proven capability.

Bulova is an industrial complex...a combination of technical knowledge and experience, management and craftsmanship...that will fit into your "team" picture quickly and expertly.

Experience in precision design and precision manufacture is the Bulova tradition, the Bulova capability. It has been for over 80 years. For more information write—

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BULOVA

One in a series of technical reports by Bower

BEARING BRIEFINGS

ROLLER GUIDANCE– VITAL FACTOR IN BEARING LIFE

Roller guidance has been established by the Anti-Friction Bearing Manufacturers Association as a major rating factor for roller bearings. There is a direct relationship between this factor and the life and capacity of a cylindrical roller bearing under load.

Figure 1 illustrates the results of a loose fit between a roller and the guiding ribs of the raceway. Because of lack of guidance by the ribs, the roller is free to skew and skid under load. Such a condition invariably leads to early bearing failure.

To achieve close roller fit and proper roller guidance, Bower precision grinds each bearing race on specially designed centerless grinders. In this operation, Bower positions the integral raceway ribs *from the theoretical centerline of the bearing*. This method produces bearings with high dimensional accuracy and perfect symmetry.

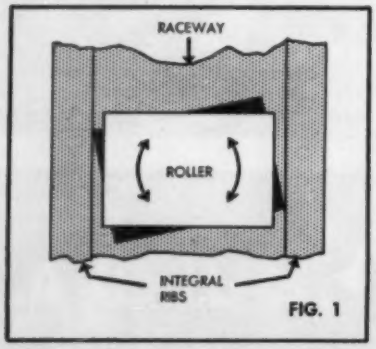
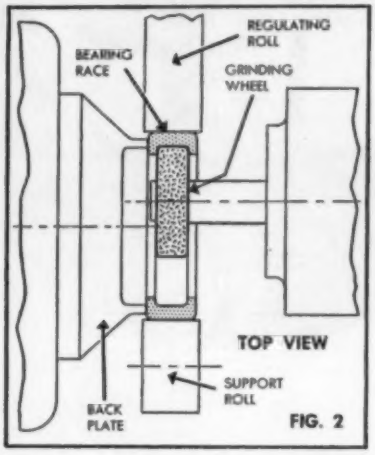
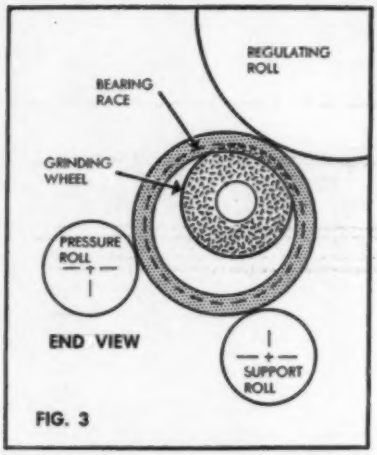


Fig. 1. Loose fit in raceway means poor roller guidance. Roller can skew and skid under load.

In addition, the close tolerances held in grinding the roller track and integral guiding ribs give Bower cylindrical roller bearings the ability to *take thrust in any direction*. A Bower cylindrical roller bearing has thrust capacity of from 10-15% of its rated radial capacity!



Figures 2 and 3 diagram the centerless grinding method used to finish Bower raceways. Use of this technique assures not only optimum roller guidance and maximum bearing life, but also virtually eliminates bearing runout. BEARING SYMMETRY WHICH RESULTS FROM THIS TECHNIQUE PERMITS ACCURATE SHAFT LOCATION REGARDLESS OF HOW THE OUTER RACE AND ROLLER ASSEMBLY ARE INSTALLED. IT COMPLETELY ELIMINATES THE POSSIBILITY OF IMPROPER INSTALLATION.



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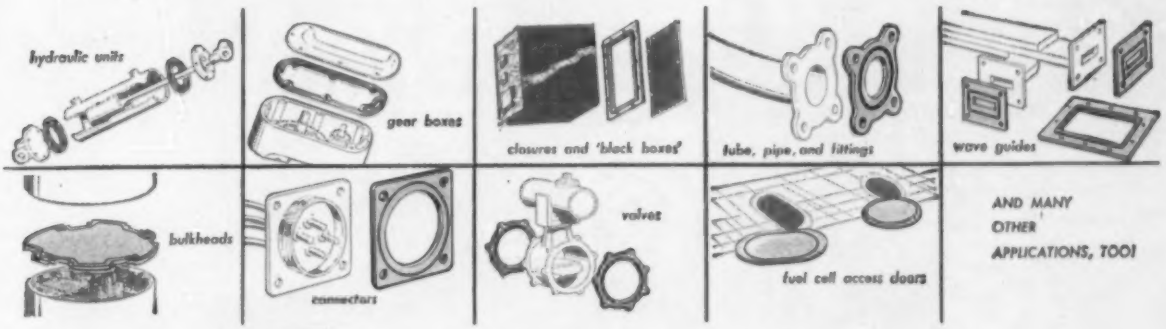

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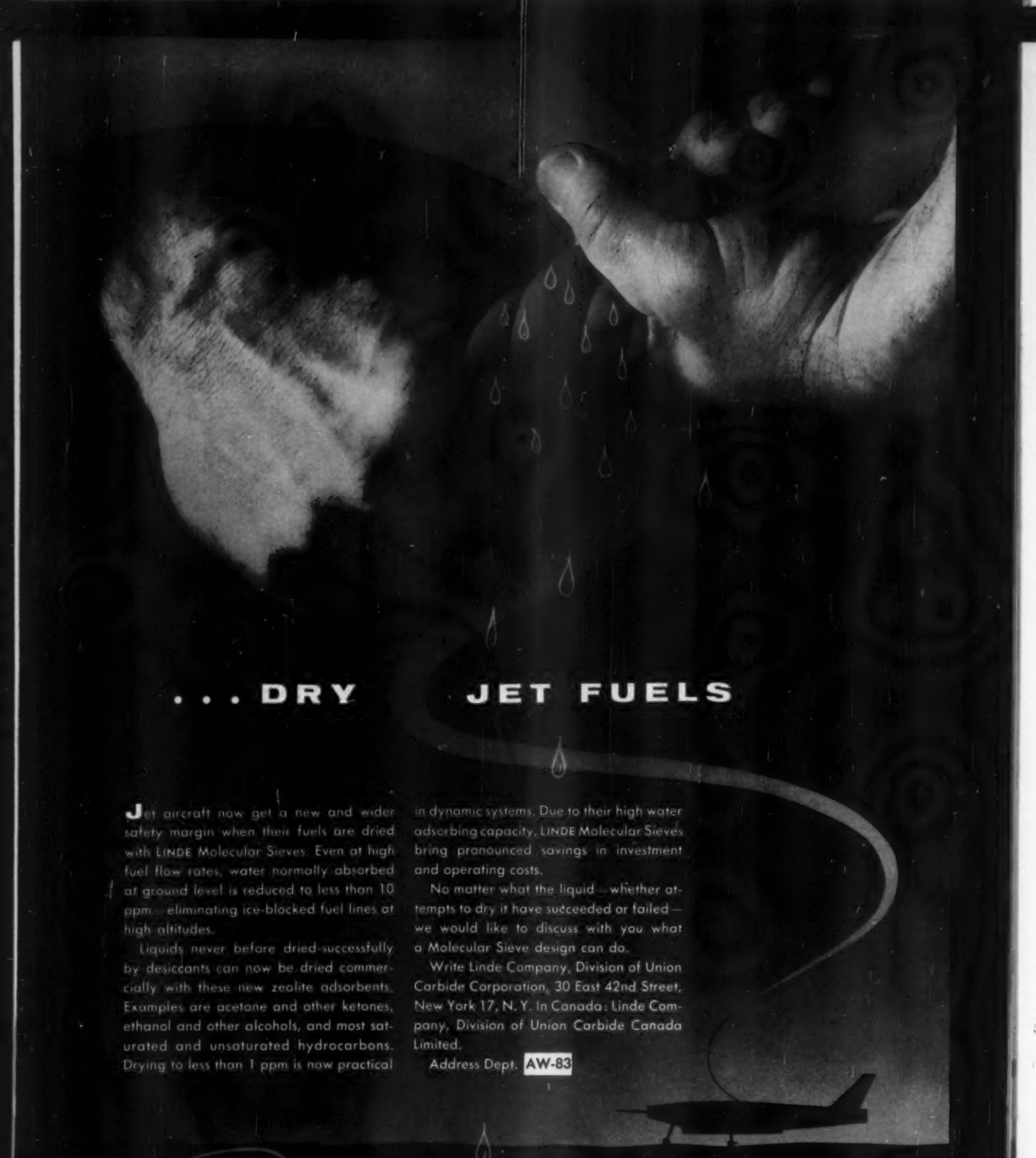

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COVER—Pan American World Airways Boeing 707-120 Clipper Tradewind taxis past Aeroflot's 170-220-passenger Tupolev Tu-114 while the latter was running up its 12,000-shp.-plus Kusnetzov turboprop engines during its visit to New York International Airport (AW July 6, p. 38). PanAm and the Soviet airline, Aeroflot, would cross the Atlantic from New York to Moscow under a reciprocal agreement still pending. For further details of the Tu-114, see pp. 50-51.

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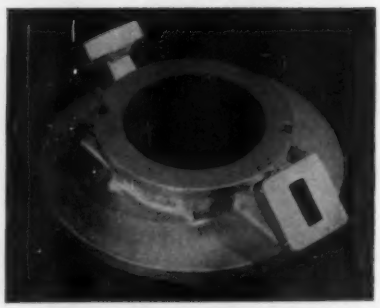

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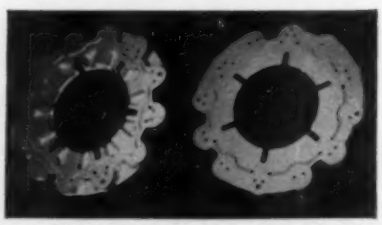

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EDITORIAL

Defense Trends

The passage by Congress of the Fiscal 1960 Defense Department appropriation bill provides some interesting clues to the trend of the defense business over the next three to five years if present policies continue.

Signing of the Fiscal 1960 appropriation bill into law by President Eisenhower will touch off a series of announcements from the Pentagon canceling and cutting back major weapons development and procurement programs. As is usual in such cases, the official excuse will be that these slashed programs are "marginal" and that it is "unwise and uneconomical" to continue them in view of the new super weapons that are just around the research and development corner.

In fact, the military usefulness of these weapons will have little to do with these actions. They are dictated solely by budget considerations that are getting tighter and tighter each year while both the Congress and executive branch of the government fail to face up to the genuine problems of providing a technologically modern and militarily superior defense program.

A further indication that the fixation with a constant-level defense budget in the face of rapidly expanding problems is the key to our defense program is found in Defense Secretary McElroy's frank admission that the Fiscal 1961 budget will require a 10% across-the-board cut in all weapons development and production programs. This 10% across-the-board cut for Fiscal 1961 piled on top of the major cuts already required by the Fiscal 1960 budget cannot help but result in a greatly reduced defense capability in the critical decade of the 1960s.

The dilemma in which the Pentagon now finds itself with a constantly decreasing defense capability (this is what the slogan of a constant-level defense budget really means) in the face of a constantly increasing challenge from the Soviet Union is a result of the failure of military and civilian defense leaders, the Congress and the President to really tackle and solve the complex technical, fiscal, and organizational problems involved in forging a truly effective modern defense capability.

Basic fault lies with the military hierarchy that has constantly placed its individual service welfare above the over-all considerations of an effective national defense.

The inability of military leaders to make decisions and settle vital matters of military policy within the framework of the Joint Chiefs of Staff has resulted in the imposition of a superstructure of civilian "experts."

These "experts" were given the job of making the decisions the military dodged and of revamping the obsolete land, sea and air structure of the defense organization. This superstructure of civilian bureaucracy erected on top of the military politicians has also failed signally in making any effective progress. It has simply added another tangle of red tape to Pentagon processes. And by its failure to make decisions, it has opened the door for the bookkeepers of the Budget Bureau to make vital military decisions based solely on fiscal considerations. The Jupiter-Thor parallel production programs, the Nike-Bomarc row in which Mr. McElroy frankly admitted the Pentagon could make no decision and invited Congress to "hold our feet to the fire," provides specific examples of how this lack of military decision wastes money without providing any real increase in defense capability.

In view of this situation, which has grown steadily worse during the past five years, it is small wonder that Congress has been drawn into the vacuum created by the Pentagon's indecision and is now attempting to play the role originally cast for the Joint Chiefs of Staff and the Secretary of Defense. We can hardly blame Congress for attempting to bring some order out of the defense chaos. But its efforts during the current session indicate clearly the ludicrous and contradictory decisions that emerge from this activity.

The Nike-Bomarc controversy provided the ultimate absurdity when a House group recommended cancellation of the Bomarc and expansion of the Nike program, while a Senate group studying the same problem branded the Nike system "militarily obsolete" and recommended expansion of the Bomarc program. Clearly not much progress will result from this type of activity.

The result of this drifting, indecisive trend where only the Budget Bureau bookkeepers will make decisions has sharpened interservice rivalry to an intensity almost beyond reason; has left the top-level civilians in the Defense Department submerged in a welter of confusion and misinformation, and has turned most of the members of Congress into military "experts" second guessing the Joint Chiefs of Staff. All of this means that we are getting precious little in genuine defense capability from the close to $40 billion we are pouring annually into the Pentagon hopper.

The pitifully small forces we were able to move to meet the twin crises in Lebanon and Formosa last year provide a measure of this sad situation. While defenders of the military budget have cited these efforts as proof of our effective defense capability, it is interesting to note that they have not discouraged the Communists from attempting similar efforts, including the brush fire now burning in Laos.

More money is certainly not the sole answer to our future defense problem. We need to make more effective use of the billions already provided before valid claims can be made for more.

What we need even more is development of a technically and politically modern defense strategy and a defense organization that effectively integrates all elements of the three services into this strategy rather than attempting to equip each service to do the entire job by itself.

We also need a program to honestly inform the American public on the requirements of such a defense program in place of the manipulated half truths now emanating from the top level of the Pentagon in a futile effort to varnish over the expanding cracks in our defense structure.

We also need a determination that extends from the grass roots of our 50 states up into the White House and Congress that we can and will do whatever is necessary to preserve this country as a beacon of hope shining out over the dark seas of Communist oppression.

—Robert Hotz

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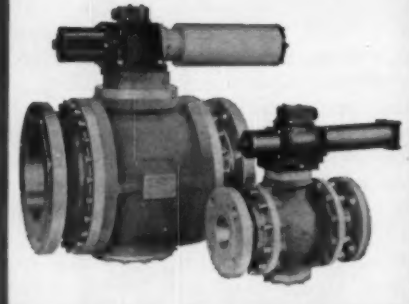

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Howard W. Helfert, Chief, International Field Service Division, Office of International Coordination, Federal Aviation Agency, Washington, D. C.

(*Continued on p. 128*)

INDUSTRY OBSERVER

► Project Transit, primary space program for which Navy has been given the go-ahead by Defense Department thus far, envisions placing a navigation satellite system into orbit by 1964-65. Boosters for the project will be purchased by the Navy as off-the-shelf items.

► **Initial evaluation tests on Tactical Air Command's "portable overseas SAGE" air defense system will begin in the near future at Shaw AFB, N. C., using five radar sites located at air bases in North and South Carolina and in Georgia. The system, identified as 212-L, includes three types of search radar—a short-range low-altitude set; the AN/MPS-20 three-dimentional surveillance radar using an air-inflated antenna; the third a two-dimensional AN/TPS-22 extremely long-range set. Last two are produced by Westinghouse Electric. Tactical air control computers are supplied by Remington Rand. General Electric is responsible for systems integration plus design of data processing and display subsystems.**

► Army recently met with four companies competing for its Mauler field air defense missile program to learn of any new ideas that had been developed since the original proposals were submitted in December. The often-postponed decision is now expected to be made within the next several weeks. Bidders include a Convair-Raytheon team, General Electric, Martin and Sperry Gyroscope Co.

► **Navy, if it can find the money, is considering retrofitting the Douglas A4D attack bomber with the 7,500-lb.-thrust Pratt & Whitney J52 engine. Navy officials say installation of the J52 as a replacement for the present 7,200-lb.-thrust Wright J65 should provide substantial improvements in performance and reliability.**

► Navy also may adopt the 8,000-9,000-lb.-thrust Pratt & Whitney JTF-10A-1 aft fan engine developed for Douglas' DC-9 short-range jet transport for use in the Grumman A2F "slow" plane designed to maintain a speed of Mach 9 at sea level. Original program called for use of the J52 turbojet in the twin-engine A2F. Under present planning, first production versions of the JTF-10A-1 are not scheduled before the summer of 1962.

► **More than 100 of the nation's top civilian and military scientists completed a 10-day symposium last week on ballistic missile defense problems and possible solutions. Classified symposium was sponsored by Advanced Research Projects Agency.**

► Last of the presently programed Nike Hercules anti-aircraft missile installations for the continental U. S. is scheduled to be in operation by mid-1960 according to present timetables.

► **Navy hopes to fire the first sea-launched Polaris fleet ballistic missile from the USS Compass Island within the next four to six weeks.**

► National Science Engineering Co., Pasadena, Calif., is conducting advanced analytical studies relating to the dynamic response of Navy's Polaris fleet ballistic missile system under subcontract to Lockheed's Missile and Space Division.

► **North American Aviation and Boeing Airplane Co. are performing lunar observatory analyses for Air Force under Study Requirement 183, with contracts of approximately $100,000 each.**

► All Douglas Nike Ajax and Hercules anti-aircraft missile units scheduled for use by the Italian air force will have the primary mission of defending the Corporal missile sites of U. S. Army's Southern European Task Force in northern Italy (AW July 20, p. 31).

► **Douglas Aircraft officials say the Nike Zeus system will have an anti-satellite capability in addition to its principal design function of destroying ballistic missiles.**

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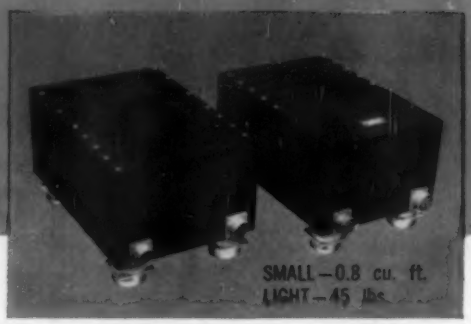

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Washington Roundup

Radical ARDC Shuffle

Radical reorganization plan to regroup all Air Research and Development Command activities under four divisions—Ballistic Missile and Space, Aeronautical Systems, Electronic Control and Command and Research—was scheduled to be presented last week to Lt. Gen. Bernard A. Schriever, ARDC commander, for his approval. Under the plan, ARDC would establish a central headquarters for all of its electronic activities in the Boston area to direct and coordinate efforts of Cambridge Research Center's Electronics Directorate, the Rome Air Development Center, and most of the avionic equipment laboratories at Wright Air Development Center. Headquarters for Aeronautical Systems Division, responsible for manned aircraft and related weapons, would be located at Wright-Patterson AFB in Dayton. Ballistic Missile and Space Division headquarters probably would be located at Edwards AFB, although Holloman AFB is a contender. Research Division headquarters probably would be located in Washington. Weapon System and Electronic Support System Project Offices, now in Dayton, would function as part of the appropriate division, and they probably would move to Boston.

If approved, the plan, prepared by an ARDC group headed by Col. J. C. Maxwell, is expected to result in transfer of some avionics personnel from WADC and RADC to the new Boston division headquarters.

No Rush for ANP Changes

Apparently there is no hurry at top Defense Department levels to find a new management approach for the Aircraft Nuclear Propulsion program. Defense Secretary Neil McElroy has said there are some considerations of new approaches afoot, but that no proposals have reached him yet. As for a deadline on new management proposals, he said: "Well, I'd say that this isn't something that I am pressing for. I really don't have a time in mind."

ANP program director Maj. Gen. Donald Keirn is retiring, and this has been suggested as a good time to review ANP management technique and find a fresh approach. Air Force has appointed Brig. Gen. Irving L. Branch to replace Keirn in his USAF job, but Branch was not named to take Keirn's jobs as director of the Defense Department and Atomic Energy Commission ANP efforts (AW Aug. 10, p. 25).

Bomarc Base Study

Department of Defense is making a detailed study of the possibilities of locating Bomarc sites in Canada. House Appropriations Committee voted construction funds with this understanding. The money for sites in the northwestern part of the U.S. between the Great Lakes region and the Pacific Coast won't be used until the study is completed and prospects for the Canadian sites explored.

The committee commented that Defense Department's "master plan" of mixed Nike Hercules and Bomarc installations for air defense "is a major step in the right direction," but it is "by no means the final answer, it leaves much to be desired . . ."

Defense Secretary Neil McElroy was in Canada last week discussing North American air defense matters with Canadian Defense Minister George Pearkes. Discussions included the role of Bomarc, a matter of particular interest since Canada has decided to rely on the Boeing interceptor missile in place of the canceled Avro CF-105 Arrow manned jet interceptor.

Mace Site Funds Deleted

In another area, the House last week took another action to discourage Air Force from buying any more tactical surface-to-surface Martin Mace missiles. It cut $6.4 million for Mace facilities in Europe from Fiscal 1960 construction funds, which are now awaiting action by the Senate. Earlier, the House cut Mace procurement funds from the Fiscal 1960 Department of Defense budget. After a strong plea from Air Force, the Senate granted authority to transfer funds from other projects for Mace if the Secretary of Defense first certifies to the House and Senate Appropriations Committees that it is "essential." The House agreed to this Senate proposal.

Khrushchev's Military Sight-Seeing

Soviet Premier Nikita Khrushchev will be free to inspect a wide variety of major military installations when he visits the U.S. next month, but it will be up to him to decide whether he wants to visit military bases. Khrushchev has indicated he wants to avoid military installations to avoid giving his visit a warlike cast, but both President Eisenhower and Defense Secretary Neil McElroy think the Soviet premier ought to get a first-hand picture of the strength and competence of the U.S. military posture. Eisenhower said last week that Khrushchev will have a fairly wide choice in the character of installations open to him, and McElroy has suggested that Air Force Missile Test Center at Cape Canaveral and a Strategic Air Command base are the types of installations he might see.

McElroy's press conference statement that Khrushchev might be admitted to installations seen by the press but not open to the American public inspired Assistant Secretary of Defense for Public Affairs Murray Snyder to insist on a clarification. McElroy said that Snyder "feels that when I said that we would show him (Khrushchev) things which the average American citizen is not allowed to see, he thinks that I should follow that with a statement that we would not violate any law in doing so and the things that you people in the press have seen are things which the average citizen is not allowed to see, but that there also we are careful to abide by the law in the way we extend this privilege to you. . . . I am not wholly sure why that is required, but I abide by my expert advice."

Petty Resigns

George R. Petty, Jr. resigned unexpectedly last week as president of the Flight Engineers International Assn., with FEIA executive vice president Ronald Brown taking over until the vacancy can be filled at a union election scheduled for this spring. Petty resigned for "personal reasons," according to an FEIA spokesman. His resignation, however preceded a planned meeting between FEIA and the AFL-CIO to discuss the engineers' connections with the Teamsters union. While FEIA has accepted aid from the Teamsters, Petty has been opposed to any membership move to affiliate with the union headed by James Hoffa.

—Washington staff

Air Force, Navy Face Procurement Cuts

Tight Fiscal 1961 budget ceilings force reviews of weapon programs; boron fuels are early casualties.

Washington—Sharp cuts in Air Force and Navy procurement programs are now being pushed through as a result of an Administration decision to hold Fiscal 1961 defense spending at present levels plus the spiraling cost of advanced weapon systems.

Some cuts already have been ordered; others will be made within the next 60 days as the Fiscal 1961 budgets of the two services become relatively firm. Army also probably will feel the cut to some degree, but the over-all effect will be relatively light.

Denied an increase in Fiscal 1961 spending above the approximately $40-billion defense budget authorized for Fiscal 1960, both Air Force and Navy are now conducting a project-by-project survey of weapon systems in their inventory, trimming programs already approved for Fiscal 1960 in an effort to make additional funds available for top-priority projects.

Air Force already has ordered a halt to the development of the high energy fuels and the General Electric J93-5 chemical engine planned for the North American B-70 Mach 3 bomber, and cut the Fiscal 1960 procurement program for Convair's B-58 Mach 2 bomber from 40 to 32. Over-all, the Air Force has trimmed its plans for the B-58 from five wings to three, with each wing having a total of 36 aircraft instead of the 45 originally programed.

Other tentative steps planned by the Air Force include:

- **Trimming its Fiscal 1960** procurement program for the Boeing B-52H intercontinental bomber from the 70 authorized to 60.
- **Diverting development funds** planned for a new early warning and control aircraft to other channels.
- **Sharply curtailing** its buying program for the McDonnell Quail electronic countermeasures missile planned for the B-52.

Specific Navy cuts are now being thrashed out in the Office of the Chief of Naval Operations, with the final decisions scheduled to be made by the end of the month.

The cutbacks by both Air Force and Navy, however, will go much deeper than trimming numbers from authorized procurement programs. One Pentagon spokesman said last week that "we've all slashed horizontally as much as we can. Now there are going to have to be vertical cuts . . . we're just going to have to have fewer programs." (For another view on cutbacks see p. 29.)

Defense Secretary Neil McElroy, in announcing the Administration decision to hold Fiscal 1961 spending to the Fiscal 1960 level, said the decisions now under consideration are "major decisions, like certain aircraft programs, certain missile programs. . . ."

He added that "just as last year, when we came up to the making of a budget, you can't say that you are going to lop off one or two aircraft and solve the kind of problem we are up against. We are up against the justification of programs, and if they are marginal, they probably are going to have to disappear."

McElroy also stated flatly that "I think we pretty near have got to find a way to keep our rate of spending from advancing." He added, however, that he saw little chance that "we can really reduce our spending."

Latest Casualties

High energy boron aircraft fuels, the latest casualties of tightened defense spending, have been dropped back into the development laboratories by last week's Air Force and Navy cancellation of production plans.

Cancellation of the boron fuel program followed quickly upon the Air Force's decision to drop development of the General Electric J93-5 jet engine. Designed to burn conventional jet fuel, probably JP-6 in the turbojet section, the J93-5 was to use the higher energy boron fuel in the afterburner, primarily to extend operating range.

In total, these canceled fuel programs represent a government investment of more than $150 million. To date, the Air Force has spent $55 million on the development of boron-derived fuels, $45 million on the construction of a production plant at Model City, N. Y. and $10 million on the development of the J93-5. The Navy has spent $38 million on the construction of a production plant at Muskogee, Okla., and additional millions on boron fuel development, including a large pilot plant.

While the Air Force decisions are reviving speculations about the future of both the J93 and B-70 programs, as well as on the future of advanced military manned aircraft in general, the J93 and B-70, along with North American's Mach 3 F-108 fighter, are still active programs at present. New plans call for the B-70 to use the J93-3 engine which General Electric was developing in parallel with the J93-5. Designed primarily for the F-108, the J93-3 will use hydrocarbon fuels throughout, possibly some of the newer and more powerful hydrocarbon fuels now under evaluation by Wright Air Development Center (AW Aug. 10, p. 27).

Also, the boron compounds are not to be dismissed completely just yet as possible high energy fuels for future aircraft and missiles. Original orders for the cancellation of production plans specified that research and development efforts on the boron fuels are to remain active. In addition to the Air Force and Navy, National Aeronautics and Space Administration and Advanced Research Projects Agency are reported to be sponsoring research and development work on the boron fuels (including the efforts now under way to develop a solid boron-base propellant for missiles).

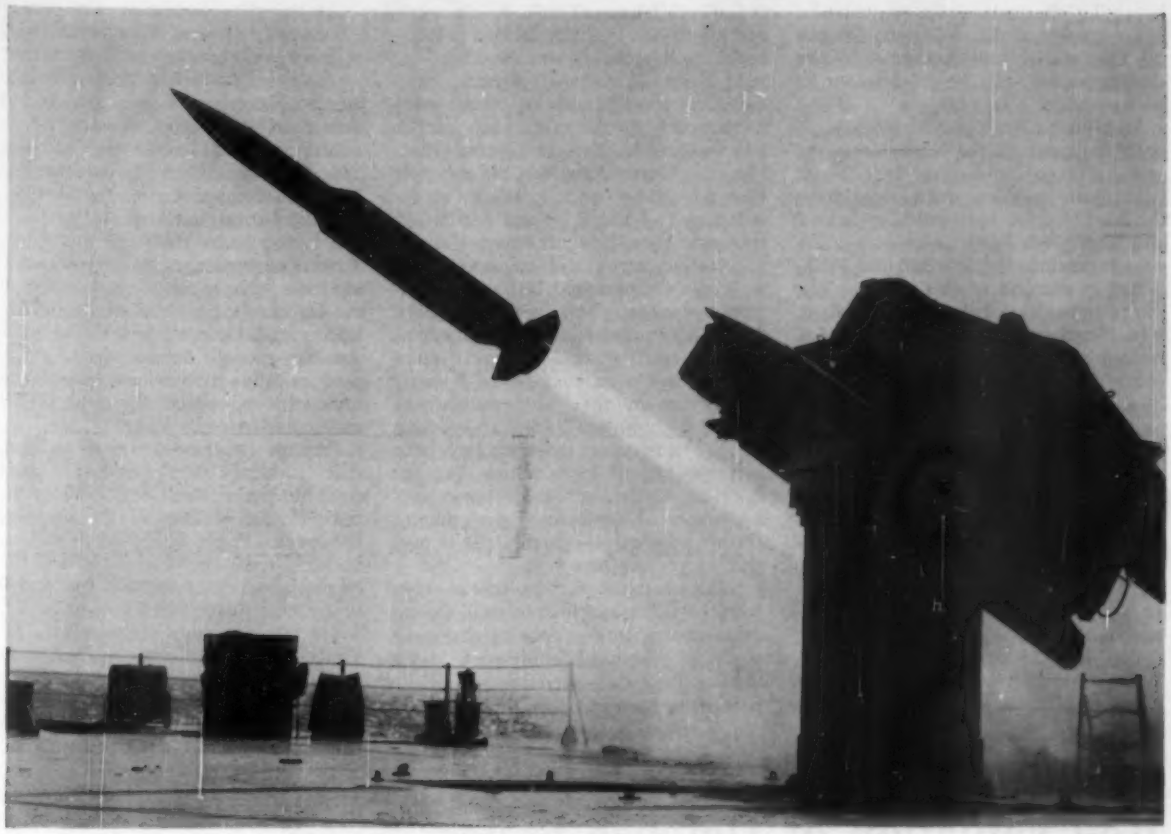
The production stop order, which is believed to have originated with the Department of Defense rather than with any individual military service, caught most Air Force, Navy and industrial groups involved in the program by surprise. All current indications are that the decision was based primarily on economic considerations, rather than technical ones.

As a liquid fuel, the boron derivatives offer a potential heat content of approximately 27,000 Btu./lb. compared with roughly 18,500 Btu./lb. for the JP-4 and JP-6 type hydrocarbon fuels. It was discovered early, however, that upon combustion in a jet engine, the boron-based fuels formed a boric oxide sludge on turbine elements, such as rotors and stators, that virtually precluded their use in the turbojet portion of the engine. The sludge also was deposited on afterburner walls, significantly lowering its efficiency.

But scientists believed they could defeat the afterburner problems of the boranes. And last February, President Eisenhower, in his report to Congress on the work of NASA, disclosed that a

XGAM-87A Engine

Aerojet-General Corp. will be propulsion subcontractor to Douglas Aircraft Co. on development of the air-launched ballistic missile, designated XGAM-87A. Aerojet-General was given the contract for early research and development work on the solid propellant engine propulsion system after being approved by a USAF source selection board.



First Photo Shows Navy Tartar Launch

First photo shows Tartar supersonic surface-to-air guided missile being launched from USS Norton Sound, a guided missile ship, off the Pacific Coast. Missile's configuration is similar to that of the second stage of Navy's advanced version of the Convair Terrier (AW July 20, p. 79). Tartar is about 15 ft. long and about 1 ft. in diameter. Missile, produced for Navy Bureau of Ordnance by Convair (Pomona) Division of General Dynamics Corp., will be primary anti-aircraft weapon on destroyers. Aerojet-General dual-thrust solid-fuel rocket generates high thrust during launch phase. Lower-thrust, longer duration burning period sustains the weapon until it reaches the target.

new afterburner had been designed and tested which was found to be "appreciably freer of the boron-oxide deposit problem than earlier versions." Plans to put the liquid boron fuels into large-scale production moved ahead. As late as last May, the Air Materiel Command's Aeronautical Systems Center at Wright-Patterson AFB was studying the matter of expanding the production facilities then under construction, in light of the large demand anticipated for the boron-based fuels in 1965.

Suddenness of Cancellation

The suddenness of the cancellation order caught the Aeronautical Systems Center off guard. Apparently, from what could be learned, USAF headquarters did not consult with either Air Materiel Command or Air Research and Development Command prior to making its cancellation decision and announcement. As a result, actual shutdown plans and procedures are still in a state of flux.

At the end of last week, however, here is what had already transpired and what was expected to take place in the near future:

• **Defense Department** awarded a contract for a study of the entire boron fuel situation to Arthur D. Little, Inc., which was already surveying this field for the Air Force (AW July 13, p. 23).

• **Headquarters USAF** last week notified Congress that it had canceled its contract with General Electric for the development of the J93-5 engine. Following this came word that it had dropped its plans to process the boron-based HEF-3 high energy fuel at its new $45 million plant in Model City, which was to be operated by Olin Mathieson Chemical Corp. The Air Force made both moves apparently without waiting for the results of the A. D. Little survey. Neither the Air Force nor the Department of Defense boron fuel study has been finished according to an A. D. Little spokesman.

• **Defense Department** announced the next day the cancellation of the Navy's plans to produce boron fuels at its new $38 million plant in Muskogee, Okla., which was to be run by Callery Chemical Co. (Actually, the Navy was reported to be on its way out of the boron fuel work long before last week's developments. It is believed that Navy Bureau of Aeronautics' original requirement for a high energy fueled aircraft became an economy casualty in last year's budget.) Up until last week, the Navy had been pressing the Air Force to take over the Muskogee operation. The Air Force was already receiving and paying for about 80% of the output of the Navy's pilot plant at Model City.

• **Following shortly** upon USAF's cancellation of J93-5 and boron fuel production, Aeronautical Systems Center received orders to close the production plant at Model City but to continue research and development effort on boron fuel manufacturing processes. Shutdown will follow this week.

• **Research and development** effort on manufacturing processes refers principally to a contract ASC Manufacturing Methods Division has with Stauffer-Aerojet for development of a low cost method of making boron-based fuels. This process will be proved out in a

large pilot plant now under construction in Sacramento, Calif.; A Stauffer Chemical Co. official told AVIATION WEEK that last week's Air Force decisions in no way affect this work.

• **At Model City,** Olin Mathieson expects to close both the Navy pilot plant and Air Force production facilities; it is currently awaiting instructions from the Air Force (on both units) as to how and when. Air Force plant was scheduled to produce the first batch of HEF-3 fuel at the end of this month. The company has closed its own pilot plant.

• **In Pittsburgh,** Callery Chemical Co. is also awaiting clarification of plans concerning the closing of the $38 million Navy plant at Muskogee. The fourth and final unit of this plant was scheduled to go into production this week. Callery's own $5 million boron fuel facility in Lawrence, Kan., will remain in operation. This plant was designed to produce small quantities of the high energy boron compounds for commercial development as well as to serve as a small interim fuel source. Callery reports that its boron fuel research and development contracts from the Air Force, Navy, ARPA and NASA are still very much alive. Consequently, most of Callery's boron research, development and pilot plant facilities, located in Pittsburgh, will probably stay in operation.

• **At Evendale, Ohio,** last week, General Electric was expecting official word momentarily on the cancellation of the J93-5 contract. Neither General Electric nor North American officials felt that this would seriously affect the development of the B-70 and F-108. At the same time, however, some General Electric scientists and engineers were avowedly disappointed by the cancellation of the boron-burning version of the J93 which they considered an important part of meeting the mission requirements for the B-70. General Electric researchers say they have studied the "super hydrocarbon" fuels (AW Aug. 10, p. 27); they feel that such fuels have a limited payoff for a vehicle like the B-70 in which the use of boron fuel was expected to increase performance (principally range) roughly 10% over that of hydrocarbon fuels.

Some chemical industry officials contend that these cancellations will among other things, further increase the hesitancy of chemical companies about getting into the aircraft and missile propellant business.

Break in Stock Market Causes Re-Evaluation of Defense Issues

By William H. Gregory

New York—Last week's stock market break, which clipped some volatile defense issues especially hard, was a culmination of a trend months in building and not merely a reaction to the Eisenhower-Khrushchev exchange of visits.

As one analyst put it, interpretation of the visits as a break in the cold war was only an excuse. Though this may have served as a trigger, the price drop was general and American Snuff suffered along with Texas Instruments.

Or as Eliot Janeway of Janeway Research Corp. put it: "The market usually says the right thing but for the wrong reasons." He felt the break was an ominous sign for the entire economy.

Janeway called the market performance in bidding defense component stocks to "crazy levels" as "irresponsible and preposterous." What with cutbacks in progress payments and price cutting on development contracts as a gamble to win a production contract, the defense contractor is financing the government, Janeway said.

"The more real defense business a contractor gets," he said, "the more money he loses. Yet these profitless prospects the market interpreted as growth."

His outlook for the future—not only for the general market which appears to be headed for a major readjustment but for aviation stocks because of the measures that will be taken to deal with defense financing—is a pessimistic one.

"They will be cutting pimples off a cancer," he said. "Whenever they get serious about defense, there is about $5 billion in redundancies that could be put into projects that are urgent."

Most market analysts pointed out the tendency for the boom stocks to feed on themselves. After their meteoric rise begins, the buyer loses sight of the traditional yardstick of dividend return and earnings and buys them to sell at a big profit to someone else. Eventually, the end of the buyer string is reached and the painful reaction begins.

Two long-term trends in aviation stocks now have evidently reached the same common denominator:

• **Some aircraft stocks** have been working downward in cycles since 1956. That year the price range for Douglas Aircraft was 95-72. The next year the range was 91-50 and last year it was 74-54. Last week Douglas was selling at $45 a share. Boeing Airplane Co. in 1956—after a stock split—sold in a 65-45 range. The next year the range fell to 61-29. Last year the range was 58-34 but after closing at year end at $46 Boeing last week was down to $33.

• **Some rocket and avionic** companies on the other hand had prices rise into the exosphere in the same period and seemed on the verge of attaining escape velocity. Prices 40 or 50 times earnings were not uncommon for stocks like Thiokol Chemical Corp., Aerojet-General and Litton Industries.

A banker added the result this way:

"If cuts or changes in defense spending were going to affect the fortunes of the big, well-established companies like Boeing and Douglas, how could there also be enough defense spending to produce the tremendous growth assumed by the market for some of the rocket and avionic stocks?"

Perhaps the Eisenhower-Khrushchev visits suddenly emphasized this question, but the market's doubts about the answer were obvious in the wavering last week. Prices rallied after the big break Monday, but brokers passed this off as the expected reaction and waited to see what the real trend might be.

Uncertainty about the future in the aviation field was creeping noticeably into the market three months ago.

Boeing, Douglas and General Dynamics were affected early, not primarily because of worries about shifts in defense spending into missiles and electronics but because the big commercial jet programs of both were resulting in heavy development writeoffs.

With stocks such as Martin Co. showing sharp rises about the same time, this might have been dismissed as switching from companies identified primarily by the public with airplanes to companies regarded as strongly entrenched in missiles.

But in July Aerojet-General brought a 175,000 share new issue of common stock to the market, priced at $75 a share. Based on Aerojet's 1958 figures, this was 55 times the company's earnings of $1.38 a share.

The stock, though not gobbled up, was sold successfully, but the underwriter began moderate, short lived market support operations in a few days involving a few hundred shares to hold the price at $75. When blocks of 1,000 shares or more hit the market, the support could no longer be maintained. The price broke to around $70 a share, backed and filled for a week or two. Then the selling wave last week carried it to around $55.

Some analysts felt that the break was only an interruption in the upward march of stocks, but there seemed little doubt that aviation and avionic stocks would be under a cloud for the next few months.

A reaction from Bache and Co. is typical of the attitude of the market:

"Although the announcement that President Eisenhower and Premier

Khrushchev will exchange visits this fall had little immediate impact on the securities market, we believe that the news makes a fresh look at the aircraft industry necessary. . . . Needless to say, any such relaxation of international tensions, unlikely as it may seem, would most likely be translated into lower defense spending, darkening the outlook for aircraft issues."

Bache went on to recommend switching into Lockheed, Martin Co. and North American—the latter two being virtually 100% military producers. The reasoning was that if there is no break in the cold war, these issues should do well; if there is, these same companies would be in a strong position to compete for the smaller number of defense contracts.

It viewed the prospects of Boeing, Douglas, and General Dynamics as less favorable because of the heavy development expenses of commercial jet transports. Regardless of the pros and cons of this line of thinking, which is common in the market currently, there were developments to support it and to add to the market jitters:

• **United Aircraft Corp.** cut its quarterly dividend from 75 cents to 50 cents a share and reported first half sales and earnings of $545,512,546 and $15,758,616, respectively, had declined from $635,808,103 and $22,377,699 last year.

• **Boeing Airplane Co.** reported a sharp drop in first half earnings—from $19,572,367 or $2.78 a share last year to $3,551,688 or 48 cents a share this year. Sales fell from $860 million for the period last year to $667 million.

• **General Dynamics** reported earnings for the first half fell almost 50%—from $20,052,000 last year to $10,658,000. Sales showed a relatively small decline from $789 million last year to $752 million this year.

United's dividend cut was no real surprise to the market, although it knocked the share price down from $51 to $48 on the news. United's own-funds research and development expenses for the first half of 1959 totaled $12,300,000, might increase to $30 million by year-end, and 50% or more beyond that figure in 1960. Expenditures for new buildings and equipment are projected to total $60 million in the next 18 months and bank borrowings, which amounted to $52.5 million as of June 30 are expected to increase to a much higher level by year-end. Although 1960 sales will remain high, the corporation said it seemed advisable to cut the dividend in the light of these burdens on earnings.

News of the boron fuel cancellation gave Wall Street a special case of the jitters. Though the North American B-70 program itself seemed secure, many investment houses — Smith, Barney and Co.; Bache; Kidder, Peabody, Burnham and Co., and Newburger, Loeb and Co.—had issued reports recommending North American for purchase.

Where the day-to-day market may tend to obscure the basic long-term trends, the operations of the mutual funds and institutions may provide a better over-all indication of what is happening.

An example is Keystone Custodian Funds, Inc., which manages a $479 million stock portfolio broken into several types of individual funds. Keystone is switching away from the aircraft field for the time being, but is adding to its airline holdings.

The Keystone Growth Common Stock Fund S-3 eliminated United Aircraft and Boeing sometime ago, but is holding Cessna and Piper in the business plane field and several airlines.

"The basic deterrent to investment in this (aircraft) industry," Keystone said, "is technological progress and cost inflation, neither of which trends seem likely to be soon reversed. The first factor implies increasing proprietary research and development, short production runs and constant exposure to obsolescence, all conditions equating with narrow and unreliable profit margins."

A check by AVIATION WEEK of changes in fund portfolios over the past two years showed no clear trend through the end of last year. In the first four months of this year, a clear trend away from Boeing, United Aircraft and Douglas became apparent. For example, after totaling the results of six fund purchases and seven fund sales of Boeing, the net reduction was 155,800 shares. United Aircraft showed a minus 25,100 shares after seven purchases and six sales.

Massachusetts Investors Trust, one of the largest funds, played a major role in this. It sold 110,300 shares of Boeing in the first quarter, leaving a holding of 90,000 shares, and in the first half sold 72,000 shares of United leaving a holding of 78,000 shares.

Martin and North American were the big gainers in the aviation field. Martin showed a net rise of 117,300 shares in fund hands and North American 65,200.

Only fragmentary reports are available of recent fund transactions, but these indicate they were not very active in the aviation industry. Martin, for example, had a price run-up from the $30 range to around $60 in May after the big fund purchases and a tour of Martin missile facilities by security analysts. But the price began to work down again during the summer and was around $40 last week.

One factor that was generally overlooked by all the market analysts is the future of the U.S. space program, which may well be a billion-dollar-a-year effort (AW June 22, p. 152).

Pace Aims at Greater Civil Volume

New York—Program cutbacks are inevitable with the current emphasis on research and development, Frank Pace, Jr., General Dynamics board chairman, told the New York Society of Security Analysts here last week. But, he added:

"I think this is a good thing from the point of view of our company and for the country. From the company view, we are willing to take our chances for we are satisfied we will get our share of new business. From the country's point of view, this is the way we get the best defense systems."

However, Pace pointed out that General Dynamics was increasing its commercial volume toward a 50-50 goal. "If the net earnings of our proposed new acquisition, Materials Service Corp., were included in our 1958 figures, our volume should be 35% commercial," he said. "When our commercial jet transport business develops, we should reach or better this 50% level."

Pace said that the Convair 880 and 600 jet transport programs had met every expectation the company had for them—with one exception. The immediate market did not develop as the company expected, and it had evaluated the medium range jet market as potentially the biggest. One reason for this, he said, was the heavy financial demands on the airlines which ordered long-range jets.

Since he does not see a supersonic medium range transport in the cards, Pace said the 880 and 600 as the fastest subsonic jet could have a minimum market life of 10 years and perhaps 15 or 20.

Company President Earl D. Johnson, in reply to a question about write-offs on the project, said they were at a peak now. Barring any major certification problem—and this seems unlikely—they should begin to taper off. One reason for this, he said, was the hard lessons the company learned about big high speed airplanes in the B-58 Hustler supersonic bomber program which saved costs.

Another point is sound suppressors and reversers. Johnson said the company refused to develop the airplane unless the engine manufacturer—General Electric, with its CJ805—designed and guaranteed them. "This little tag cost one of our competitors $15 million to develop," he said.

Paddlewheel Satellite Probes Radiation

Washington—National Aeronautic and Space Administration's Explorer VI satellite, the most complex experimental payload launched by the U. S., is making a variety of measurements over a broad spectrum of space conditions as it follows its highly eliptical orbit around the earth.

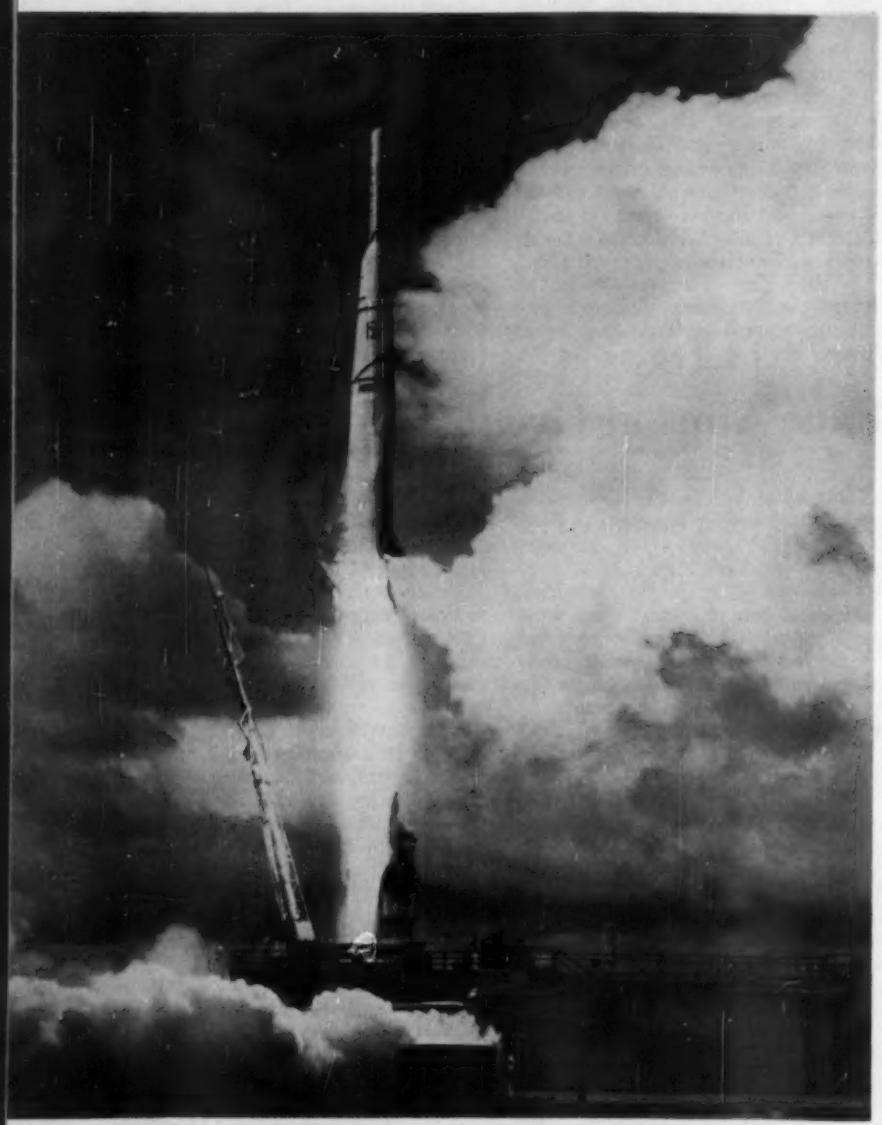
Launched from Cape Canaveral by an Air Force Thor Able III vehicle, the satellite is using a new digital telementry system to report measurements from an instrumentation complex which is using solar energy as a primary power source.

Since the four solar cell vanes protrude from the satellite to absorb solar energy resemble paddles, the vehicle as a whole has been labeled the Paddlewheel satellite by NASA.

Paddlewheel satellite also was designated Explorer VI by NASA after it went into orbit, acquiring the designation from the radiation satellite which failed to get into orbit when its Juno II launching vehicle was destroyed shortly after liftoff (AW Aug. 3, p. 61).

Radiation satellite payload will be launched again, probably next month.

Explorer VI was launched 48 deg. to the north from the Air Force Missile Test Center and went into a highly eliptical orbit with an apogee of 26,401 stat. mi. and a perigee of 157 stat. mi., a pattern very close to the orbit originally scheduled. Orbital time is 12 hr. 46 min., and velocity varies between 3,117 mph. at apogee and 22,957 mph. at perigee. Explorer VI travels 91,140 mi. in each orbital circuit.



AIR FORCE Thor Able III launches heavily instrumented Explorer VI satellite.

Launch Vehicle

Thor Able III launching vehicle was similar to previous Thor Able vehicles, using an Air Force-Douglas Thor for first stage and two modified Vanguard upper stages. Autopilot in the Aerojet-General liquid rocket second stage has been miniaturized and was lighter than previous models, and guidance system could be controlled from the ground for the first time.

Eight spin rockets were fired at second stage burnout to stabilize the payload and the Allegany Ballistic Laboratory solid propellant third stage. Explorer VI is spinning at 168 rpm. The satellite has an Atlantic Research Corp. solid rocket in it which could have been fired to provide 5 lb. of thrust to change the orbit if perigee had been too close to the earth, but this small kicker rocket was not needed.

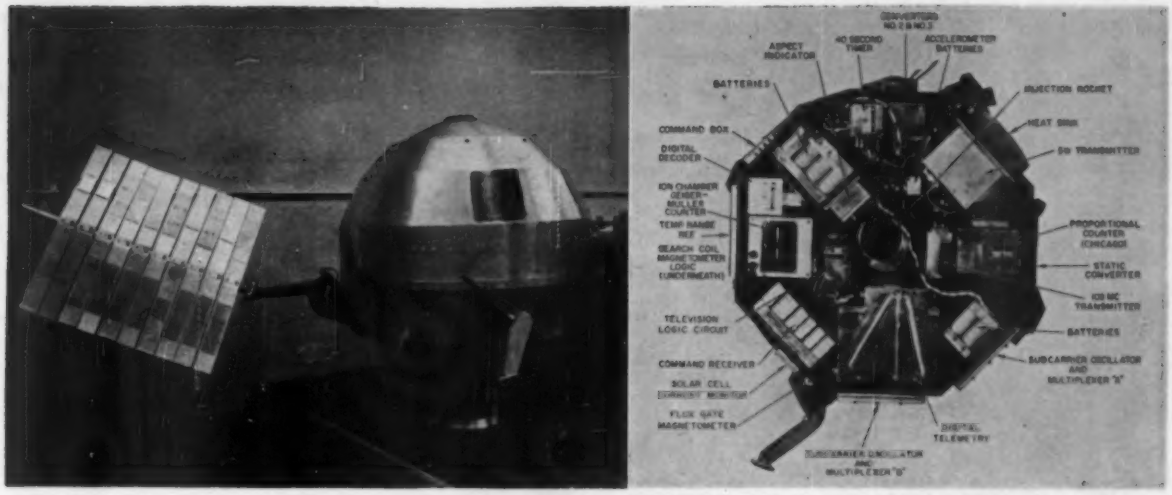
Explorer VI development and launching was an NASA project, with Air Force Ballistic Missile Division directly responsible for launching and contracting for fabrication of the satellite. Space Technology Laboratories, Inc., provided systems engineering and technical direction. A Douglas Aircraft Co. launch crew conducted the launching. Thor Able III was the 52nd Thor launching; 10 of these have been Thor Able vehicles.

Paddlewheel Structure

Paddlewheel satellite is a spheroid with a slightly flattened bottom. It is 26 in. in diameter, 29 in. deep and weighs 142 lb., and its aluminum skin is ☆ in. thick. The four solar cell paddles jut from the satellite's waist on arms that were spring-loaded to extend when the plastic nose fairing on the launch vehicle was jettisoned just before third stage ignition.

Each of these paddles is about 20 in. square, and each has 1,000 silicon solar cells on each surface. These 8,000 cells are shielded by glass filters which filter out harmful ultraviolet rays while admitting appropriate light energy. Hoffman Electronics produced the solar converters in modules of 100 cells, 50 on each side. Each module produces about ¾ watt of electricity under direct sunlight.

Solar cells charge the batteries which power the satellite systems and are expected to last as long as the satellite—about a year. A voltage gage measures solar cell output, and battery charging



TEST SOLAR paddle is fitted to satellite (left) to determine final design. Tightly packed instrumentation is at right.

rate can be changed by ground command if necessary. Complete power supply system, including batteries, weighs 30 lb. Solar cell element of the satellite operation is considered an important test of a potential power source for long range space vehicles.

Telemetry backup is provided with duplicate transmission of most experimental data by the three transmitters in the satellite. Transmitters operating on 108.06 mc. and 108.09 mc. send analog information, and the primary transmitter sends digital data on an undisclosed UHF frequency. Primary transmitter power requirements of 40 watts is too heavy for the solar cells and battery to support continuously, so the transmitter is being used on command about one and a half hours out of every six.

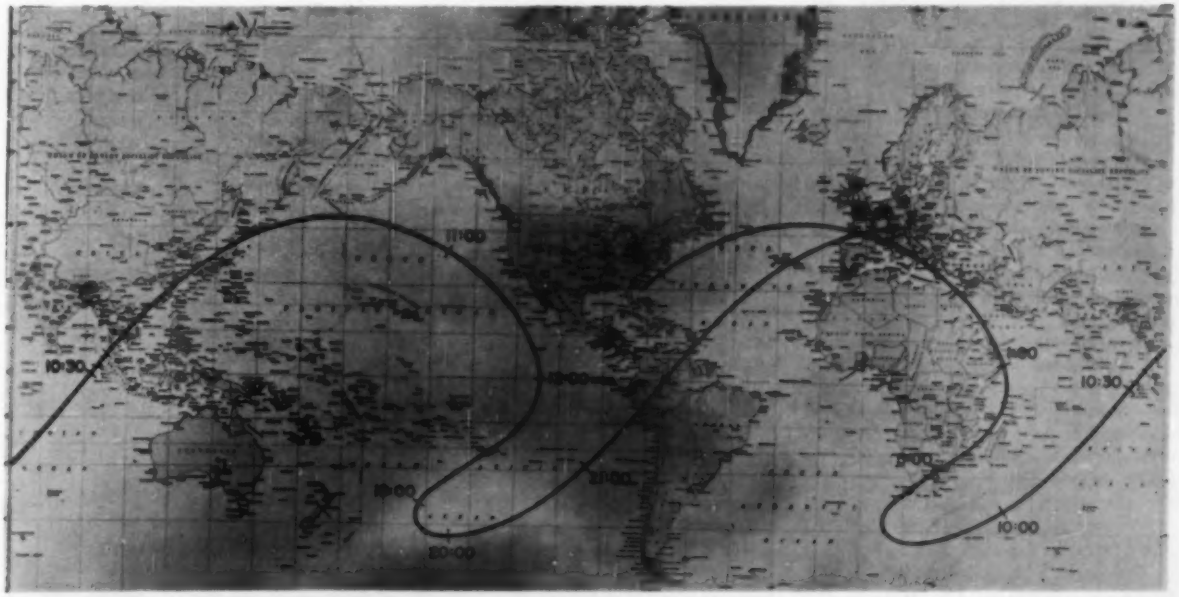
Ground command is effected through a receiver in the satellite which can control 30 different functions, including broadcast cycle of the primary transmitter. UHF frequency of the primary transmitter and command receiver is undisclosed to avoid possible outside interference with the command function. Satellite also has a VLF receiver for radio wave propagation experiments.

Digital Telemetry System

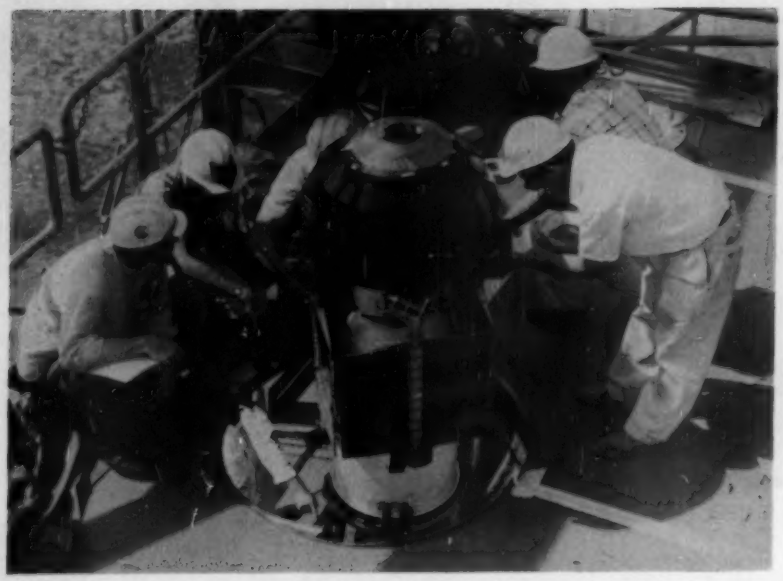
New digital telemetry system developed by STL permits on-off use of the primary transmitter. Called Telebit, this digital system stores and tallies experimental data while the transmitter is off, then transmits the processed information on command. Digital system imposes a lighter load on the power supply than the usual analog system which must operate continuously, and the digital data is more easily processed on the ground.

Transponders in the satellite are used as a doppler system to measure its velocity. This provides a checkout of a system which provides mid-course information and which could be used for mid-course guidance of satellites with more difficult missions than Explorer VI.

The highly eliptical orbit of Explorer VI permits a wide range of energy level measurements in the radiation



ORBITAL PATH during first 2½ hr. moved across Europe and Middle East relatively close to the earth. It then moved southwest toward Cape of Good Hope as satellite traveled farther away from earth and rotation caught up with Explorer's relative motion.



EXPLORER VI PAYLOAD is prepared for installation on third stage of Thor Able III launching vehicle. The 20 in. square vanes folded down below the payload have 1,000 solar cells on each side and are providing electrical power for operation of the satellite's instrumentation. Hole on top of the satellite is the nozzle of the small rocket carried to raise perigee if it had been too close to earth; it was not used.

belts. These were measured by various earlier Explorer satellites and by Pioneer I and Pioneer III, but Explorer VI will provide more copious data over a greater period of time. During its year of life, the plane of the satellite's orbit will tilt toward the plane of the equator and provide data on the radiation belts where they are strongest.

Radiation counters in the satellite are measuring three energy levels. A device developed by the University of Chicago measures high energy particles. It consists of six gas-filled cylinders surrounding a seventh cylinder and is lead-shielded. Particles will ionize the gas and create an electrical impulse as they penetrate the cylinders.

Medium energy range is measured by a combination of two instruments provided by the University of Minnesota, an ionization chamber for total flux and a Geiger-Muller tube for count rate. STL scintillation counter is used to measure low energy radiation.

Density and pattern of micrometeorites in the area traveled by Explorer VI is measured by metal plates on opposite sides of the satellite's waist. Microphones pick up impacts on the plates for telemetry transmission.

Magnetic field of the earth is measured by magnetometers designed by STL. Search-coil magnetometer gages the magnetic field and its direction, and a flux-gate magnetometer is used with it to measure the spin axis component of the field. STL also has developed a phase comparator which measures the phase relationship between the output of a sun scanner and the search coil magnetometer, providing the "H" direction of the magnetic field.

A facsimile system similar to a television camera was developed by STL for the Explorer VI payload. It scans the earth on each revolution and produces data dots which, in turn, form lines that make up a complete picture. Transmitted pictures will have a resolution of about five miles and can provide a crude picture of the earth's cloud cover.

Radio wave propagation experiments are conducted with Explorer VI to determine effect of the isonosphere. In one experiment, signals at 15.5 kc. from Navy radio station NSS at Annapolis, Md., are received by the VLF receiver provided for the satellite by Stanford University, and the results are telemetered to ground stations. In another, signals from one of the satellite's VHF transmitters may be received by two earth-based receivers spaced on a 475 meter base line to measure amplitude and phase fluctuations induced by the ionosphere. Ground equipment for this experiment is in place at the National Bureau of Standards Laboratory in Boulder, Colo.

Signals from UHF and VHF transmitters will be used at the Kalae, Hawaii station in a comparison of doppler shift. Comparing doppler shifts of the two transmitters will provide data on the relative effect of electron density in the ionosphere on signals with these two frequencies. VHF signal also will be used by the Hawaii station to measure the Faraday rotation caused by variation in electron density between the satellite and the ground station.

Internal temperature of the satellite is controlled by surface treatment of the skin. Readings are telemetered on payload temperature and temperature of the solar cells. An experimental device for controlling temperature inside the satellite being tested resembles a four-bladed propeller on the shell. A heat-absorbing black patch is on the surface with a wire coil under it. When temperature rises to a certain level, the coil expands and activates the propeller which moves to cover the black patch. When the covered patch cools, the coil rotates the propeller away, exposing the patch and allowing temperature to rise again.

Explorer VI is tracked by a number of U.S. posts, but principal command and data reception points are at Jodrell Bank, Manchester, England; Kalae, Hawaii; Millstone Hill, N. H.; Singapore, Malaya, and Cape Canaveral. These points are connected by a teletype circuit with the control point at STL's Space Navigation Center in Los Angeles. Experimental data will be partially reduced at tracking sites before it is moved to STL for complete processing.

Multiplexers have been installed on antennas at Jodrell Bank and Hawaii to permit reception and transmission of signals on a single antenna at the same time.

THOR ABLE third stage (foreground) is solid-propelled; second stage undergoes testing.

New Navy Radar Holds Promise Of Long-Range Missile Detection

By Philip J. Klass

Washington—New type radar which shows promise for detecting the firing of ballistic missile rocket engines and nuclear explosions at intercontinental distances has been reported by the Office of Naval Research.

The ionospheric back-scatter radar that can detect large volumes of ionized gas produced by hot rocket engine exhaust or a nuclear explosion operates in the high frequency band (3 to 30 mc.), normally used for long-range radio communications.

High frequency radio signals propagate over long distances, because they bounce off the ionosphere, reflect back to earth, then back to the ionosphere and back again to the earth, skipping around the globe in this fashion. At each contact with the ionosphere or the earth, a small fraction of the radio energy also is reflected backward toward its source.

It is this back-scattered energy, or echo, that is employed in the new radar. The radar transmits in short bursts or pulses, providing a non-transmitting period in which to receive the back-scattered echo.

Each reflection off the ionosphere and off the earth produces a weak echo, each displaced in time from the preceding one. When the radar energy strikes a large volume of ionized gas, such as that produced by a rocket launch or nuclear explosion, it produces an echo with a distinctive energy pattern which can be distinguished from ordinary ionosphere/earth produced echoes.

The new radar concept, credited to Dr. William J. Thaler of the Office of Naval Research, was developed under the code name of Project Teepee (or T. P.), derived from "Thaler's Project." Other groups participating in the program include the Nuclear-Products-Erco Division of ACF Industries, National Bureau of Standards, Lincoln Laboratory and the Naval Air Test Center.

The radar's advantages and limitations both stem from the fact that it operates in the high frequency band. Unlike more conventional radars which operate at higher frequencies, the new back-scatter equipment is not limited to short line-of-sight ranges. Intercontinental ranges can be achieved with moderately low powers when compared with that required by more conventional ballistic missile detection radars.

One of the more serious limitations is the fact that sun spots and solar flare-ups seriously alter the ionosphere's propagation characteristics, causing complete blackouts in high frequency radio communications. Presumably the new radar would be even more vulnerable than conventional radio communications. Furthermore, a small nuclear explosion in the upper atmosphere of the Project Argus type also could black out HF propagation for an extended period.

The new radar also may be vulnerable to electronic countermeasures. By placing a low-power HF transmitter in the vicinity of the missile launching site, an enemy could generate signals that could blot out the weak echo from rocket exhaust gases. It probably would be more difficult, perhaps impossible, to obscure a large nuclear explosion.

One high frequency back-scatter radar can provide a rough indication of the direction and approximate distance of a nuclear explosion or rocket launching, but unknowns in the propagation path make it impossible to determine location precisely. By using several radar stations, and triangulation, the target location could be established more precisely.

The new radar appears likely to find application as an early warning device to supplement other techniques, such as the Ballistic Missile Early Warning System and Project Midas infrared sensing satellites.

The technique does not now appear suitable, however, for tracking ballistic missiles to establish trajectory for aiming anti-ICBM missiles since the HF signals do not penetrate the ionosphere, hence could not follow the missile after launch.

Dr. Thaler says that "promising results have been obtained over long ranges using breadboard equipment. We are confident that a system capable of reliable detection over intercontinental ranges is feasible." However, he makes no claims for the radar's ability to track a ballistic missile. The same technique has detected a nuclear explosion "thousands of miles away," according to the Defense Department.

The idea of using the high frequency band for long-range radar is not new. More than 10 years ago, Air Force's Rome Air Development Center sponsored development of an experimental HF radar. Tests indicated that the radar had little merit for use against aircraft, the targets of interest at that time. However, the equipment did find use as a means of determining what HF frequencies were best at any particular time of day for reliable communications with a distant station (AW Aug. 17, 1953, p. 327).

Rome recently has taken a fresh look at HF radar for ICBM detection and is currently conducting an in-house investigation.

Semiconductor Advance Detailed

Pittsburgh, Pa.—"Transistorized vacuum tubes" which require no heater or filament power may result from a recent discovery that certain semiconductor crystals can be made to emit electrons, according to Westinghouse Electric Corp.

Westinghouse reports that two of its research physicists have discovered that a tiny silicon carbide crystal will emit electrons when voltage is applied across a built-in junction. Current density compares with emission from the cathode of a small receiving type tube.

The use of a tiny semiconductor crystal to replace the heater and cathode of a conventional vacuum tube could, Westinghouse says, give tubes a new lease on life in their battle with conventional transistors by eliminating the need for heater power and the consequent problem of dissipating heat.

The materials and principles employed by Westinghouse differ from those used in "cold-cathode" tubes developed by Linfield College scientists and more recently by Tung Sol Electric Co. The former requires a strong electric field to draw electrons from a point-source type cathode. The Tung Sol approach requires application of a trigger voltage to start electron emission from a magnesium oxide coated cathode. Delay in the flow of electrons after application of the trigger voltage in first models of the Tung Sol tube tends to limit use to lower frequencies.

Electron emission from silicon carbide crystal accompanies the emission of visible light in the form of electroluminescence, Westinghouse reports, when the voltage applied across the semiconductor junction is sufficient to cause the breakdown of its normal electrical resistance. The emitting spots measure only about 50 millionths of an inch in diameter, with densities of about one micro-ampere from each spot.

The fact that electrons are emitted from such tiny spot sources suggests that the new discovery might also find application in cathode ray tubes to provide an extremely thin electron beam without all of the complex focusing elements now required.

Westinghouse says it is continuing its investigation of the new technique in its research laboratories, as well as working on its application to specific devices.

Congressmen, Retired Officers Termed Sources of 'Pressure'

By Katherine Johnsen

Washington—E. V. Huggins, former Assistant Secretary of the Air Force for Materiel and now executive vice president of Westinghouse Electric Corp., told members of the House Armed Services Investigating Subcommittee last week that Pentagon officials are under "pressure" on procurement matters from both congressmen and former high-ranking officers.

Testimony by Huggins, Assistant Air Force Secretary between 1951 and 1953, was at variance with that given to the subcommittee by a number of retired officers—including Adm. Arthur Radford and Army Gen. Omar Bradley, both former chairmen of the Joint Chiefs of Staff—that during their long service careers they had seen little or no evidence of former officers influencing or trying to influence procurement.

The main emphasis of Huggins' testimony, however, was on the value of military officers to industry. He told the subcommittee that former officers "have not only technical knowledge but also a major amount of executive, administrative, and pure business ability."

Huggins reported that it is—or was—the practice in the Air Force to put a "pink tab" on the files of contractors who had employed high ranking officers to use influence on their behalf. He said the tab was "a warning flag" because the Air Force "wanted people to be aware that the fellow on the other side of the table had former Air Force connections." During his tenure as Assistant Air Force Secretary, Huggins said it was obvious that "certain retired officers were being too evident . . . were being around too much." He said Pentagon officials "resented" the "pressure" of both congressmen and retired officers.

When he heard that Westinghouse was likely to be rejected as a subsystem subcontractor on the North American B-70 Mach 3 bomber (AW May 18, p. 23), Huggins admitted that he promptly contacted Pentagon officials "to let them know our capability . . . I felt they lacked knowledge of our capability." Westinghouse subsequently received the subcontract. Hebert characterized this as "a classic example of good selling."

Other developments before the subcommittee investigating allegations of contractor influence in defense procurement included:

• **Officials of Boeing Airplane Co.** testified that they were forced to place advertisements on the merits of its Bomarc air defense system being built for Air Force in Washington newspapers to correct "misinformation" being advertised on behalf of the Army-Douglas Nike Hercules air defense system.

C. R. Smith, vice president of Western Electric Corp., prime Nike Hercules contractor, termed this "a false charge." Smith said that it was "purely coincidence" that a Western Electric advertisement on behalf of Nike appeared in Washington newspapers on the eve of an Administration decision on a "master plan" for air defense.

It also was developed at the hearings that Boeing officials had contacted the House Appropriations Committee, Western Electric officials, the Senate Appropriations Committee, in connection with the Fiscal 1960 budget for air defense. Neither company considered this exerting "influence," but simply a matter of keeping congressmen informed.

Defense Secretary Neil McElroy expressed reservations concerning the battle of advertisements in connection with the Bomarc-Hercules controversy but strongly defended "a company's right to put before the American people its confidence as supplier of high-grade military products as an evidence of its importance as a good citizen of the U.S."

• **J. D. Wright,** president of Thompson Ramo Wooldridge, conceded that "we do have a problem here" as owner of Space Technology Laboratories since the latter's role as technical adviser to the Air Force by joint Thompson Ramo Wooldridge agreement is to be completely divorced from the production operations of the company. As long as STL keeps operating in the black, he told the congressmen, "we have no interest in it. But as a duty to our stockholders, we may have to become active in its management if it were to go into the red."

A new headquarters for STL is being built at Canoga Park in southern California, 38 mi. distant from the headquarters of the Ramo Wooldridge Division of TRW to further complete divorcement of activities, Wright reported. STL's headquarters are now three miles distant. TRW elects the directors of STL.

Raytheon Wins Platform Contract

Washington—Raytheon has received a $90,000 Air Force study contract from Wright Air Development Center for the company's proposed radio-powered unmanned helicopter which can be used as a flying platform for surveillance radar or extended-range communications (AW May 18, p. 38).

Several companies have submitted airframe proposals to Raytheon, including Sikorsky and Vertol.

The platform, which could hover indefinitely at altitude, would be powered by microwave energy beamed up to it from a ground radio transmitter. It would use a small gas turbine, powered by conventional fuel for initial takeoff and climb to altitude, to drive compressed air through tip jets in the rotor blades. Once on station, the vehicle would be maintained aloft by microwave energy beamed up to its antenna.

Raytheon estimates that approximately 1,000 hp. at the rotor would be required to sustain the vehicle and its airborne avionic equipment. To provide 1,000 hp. at the rotor, the company estimates that approximately 20,000 hp. (15,000 kw.) of electrical generating capacity would be required on the ground, based on over-all system efficiency of about 9.6%. The latter figure assumes a 65% efficiency for the ground-power transmitting antenna, 75% pattern efficiency, 65% efficiency for the airborne-power receiving antenna and 30% efficiency for the airborne propulsion system.

Recent advances in techniques for cooling Raytheon's Amplitron microwave power amplifier tube have opened the door to the novel radio-powered flying platform. In the past year, the company says it has devised means for removing 10 times as much tube heat as previously possible.

Raytheon reports it is now producing Amplitrons that can deliver 20 hp. at 3,000 mc. frequency and says that 100 hp. units will be available within two years. With another several years of development, Raytheon believes it can produce tubes with outputs of 500 hp.

Ability to generate such large amounts of power at higher microwave frequencies, with sufficient phase stability to permit parallel operation of many tubes, makes it possible to transmit sufficient power to sustain a useful payload using moderate size antennas. Present thinking is that a group of small antennas located in 400 sq. ft. would serve for the ground station. Like a battery of searchlights, their beams would be aimed to converge at the flying platform's hovering altitude into a circular spot less than 100 ft. in diameter. Helicopter would carry a light-

J79: world's most-flown Mach 2 engine

General Electric's J79 turbojet has demonstrated its reliability by logging more flight hours than any other Mach 2 engine in the world. Typical of the J79's record is its outstanding performance in the Lockheed F-104 Starfighter—world record holder for speed, altitude, and time-to-climb.

Operational flying with the USAF's Air Defense Command and Tactical Air Command demands the most of an aircraft and its engine. In the face of these requirements, the F-104 is compiling an outstanding record.

Evidence of its J79 engine's reliability grows more overwhelming daily. During 1959, USAF Starfighters have been realizing an unusually high aircraft utilization rate, with a correspondingly low percentage of in-flight engine complaints.

Some key reasons for the J79's outstanding operational record are the simplicity of its single rotor variable stator design, high resistance to foreign object damage, unusual throttle sensitivity, high altitude afterburner light-off characteristics, and ease of maintenance.

More than 90% of total U.S. Mach 2 flight time has been logged by General Electric J79s . . . further evidence that it is today's top Mach 2 fighter-interceptor powerplant. General Electric Co., Cincinnati 15, Ohio. 235-32

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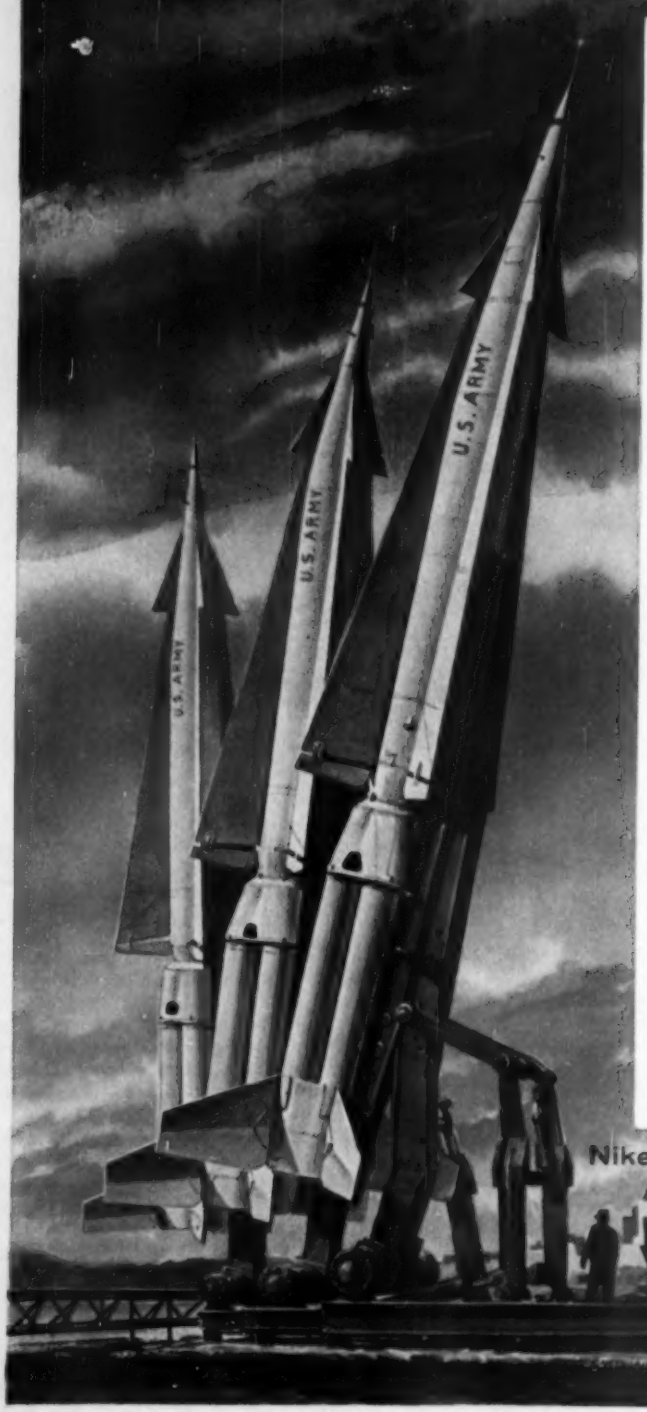

U. S. Army's

NIKE HERCULES...

Solid rocket motor built by Thiokol for Nike Zeus has produced greatest mass discharge rate and thrust of any single

Through the combined efforts of the U.S. Army, Western Electric, Douglas Aircraft, THIOKOL Chemical and other key members of the missile industry, America is moving toward the realization of a critically needed anti-missile missile.

The Nike-Zeus system — big brother to the Army's Nike Hercules which now stands guard over major population centers — is being designed to detect, charge and destroy attacking ICBMs many miles from their targets.

Assigned development of the boost for the Zeus, THIOKOL has already designed, built and successfully test-fired a motor achieving over

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Nike Hercules

NIKE ZEUS

solid propellant motor ever test-fired in the free world . . . unleashes more than 400,000 lbs. of thrust in static firing!

400,000 pounds of thrust—power enough to deliver the instant reach of high altitudes needed for effective defense.

While the Zeus booster stands as the most powerful solid propellant motor now on record, it in no way represents the ultimate capability of present THIOKOL facilities. Current capacity includes motors still larger—of ICBM and even satellite size.

Under Army direction, and in cooperation with Douglas Aircraft, THIOKOL development in the Nike program has advanced the science of rocket propulsion.

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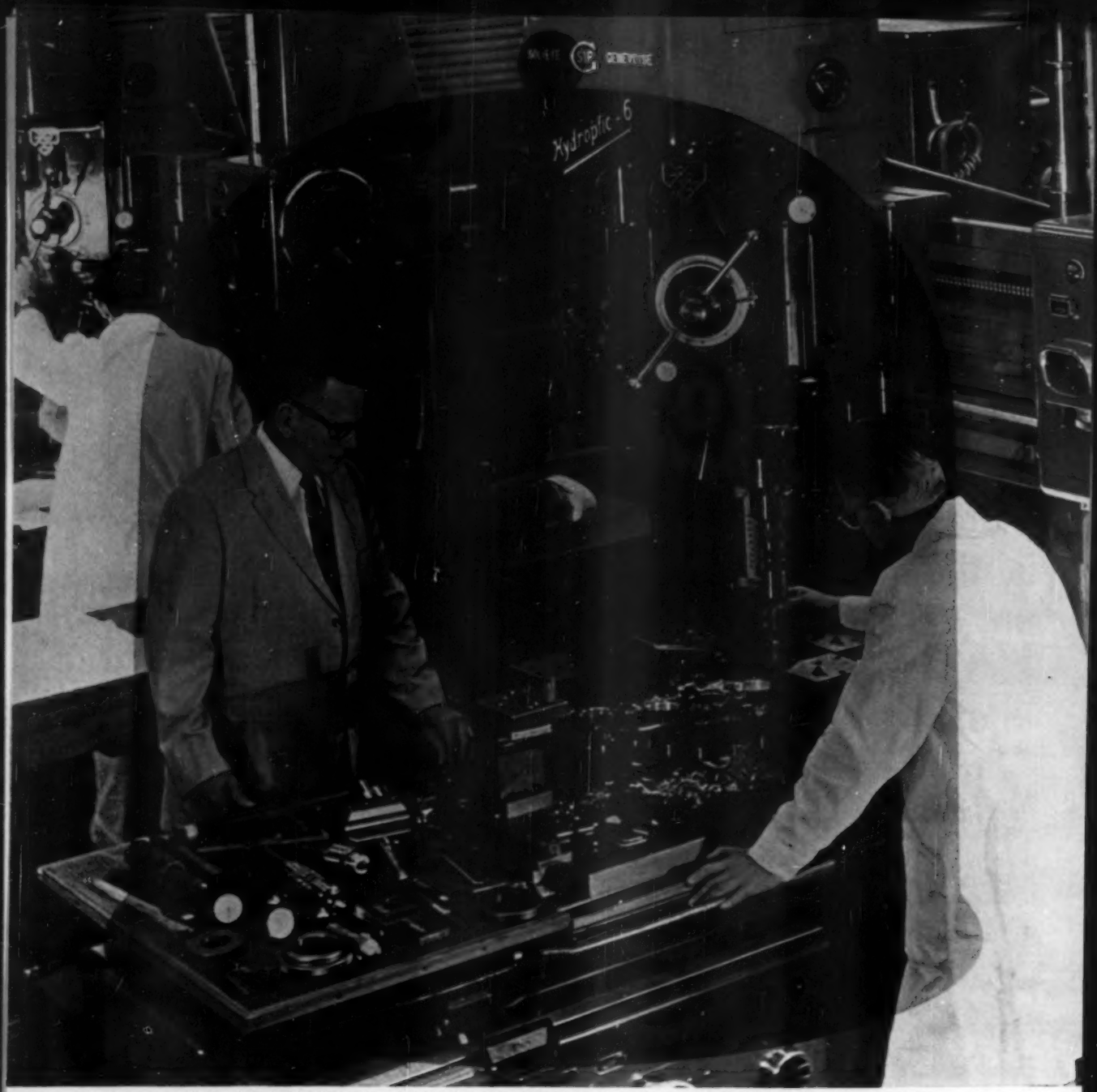

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weight circular receiving antenna of about the same diameter.

Microwave energy received by the vehicle's antenna would be carried by waveguide to glossy elements which would convert it into heat. Compressed air or gas heated by these elements would then drive the turbines which supply power to the rotor tip jets.

In addition to the fuel carried for initial takeoff and climb to station, the vehicle would carry a small reserve to tide it over in the event it briefly moves out of contact with the ground-transmitted radio beam.

To hold down the weight of the vehicle's payload, Raytheon proposes that the flying platform used for radar surveillance carry only the search antenna, duplexer and a receiver instead of a complete airborne radar. The radar signal would be generated on the ground and transmitted to the search antenna, and the received radar signal would be telemetered back to the ground. The Amplitron tubes used to supply power lend themselves to various forms of modulation, permitting the radar pulse-form to be superimposed on the power beam, then extracted at the vehicle and routed to the search antenna.

A series of flying platforms could be used as a chain of microwave repeaters to provide secure communications in the Arctic or over the Atlantic, Raytheon says. At microwave frequencies, 30 mc. bandwidths can be obtained which would provide more radio channels than now available in the entire high frequency band used for long-range communications and without the frequent outages due to ionospheric disturbances.

Unions Outline Industry Demands

Seven-point bargaining program for 1960 was adopted by union representatives of aircraft, missile and related electronics workers at the International Association of Machinists and United Auto Workers joint conference in Kansas City, Mo.

The seven basic proposals, which will be presented at the next round of negotiations with major employers in the aerospace industry, are:

• **"Wages**—Actual cents-per-hour wage increase to be sought in the next negotiations will be decided at a joint IAM-UAW 'price tag' conference to be called later this year. . . ." Unions stressed elimination of inequities in job classifications and changes.

• **"Severance pay**—Any employe who is laid off or terminated and who has one year or more of service should receive severance pay proportionate to this length of service, in addition to payment for any unused portion of vacation or sick leave allowance for which he or she is eligible. Severance pay shall be one-half day's pay for each month of service.

• **"Relocation pay**—Any employe whose work site is transferred or moved from his initial place of employment shall be entitled to pay for travel time and compensation for the expenses of maintaining two homes, or for disrupting and moving his home.

• **"Union security**—Achievement of union shop across the board in the aircraft and missile industry is a basic and serious objective for both unions.

• **"Hospital, surgical and medical** insurance—There should be established a sound and adequate basic benefit which will satisfy the normal and usual hospital, surgical and medical requirements of the employes. . . .

• **"Life insurance**—In those contr. "s where life insurance coverage does no at least equal average annual income every effort should be made to achieve this objective. . . .

• **"Pensions**—The following principles will be adhered to in renegotiating pension contracts: The plan shall be 100% employer financed; systematic funding of benefits will be provided on a sound basis; all aspects of the plan will be jointly administered. Provision should be made for voluntary retirement before age 65. Workers should be entitled to $1,000 lump sum benefit on death after retirement. We should strive to protect the purchasing power of the pensions by provision for adjustments geared to changes in the cost of living."

Third X-15 Delivered

Third North American X-15 rocket research aircraft is undergoing instrumentation check at National Aeronautics and Space Administration high speed station at Edwards AFB.

The third X-15 will demonstrate contractor compliance; the first two X-15s were used for aerodynamic and powerplant testing, so the No. 3 vehicle will require less flight testing before beginning actual research program flights.

A metal mockup of the Reaction Motors 50,000-lb.-thrust XLR99-RM-1 rocket engine is installed in the third X-15, prior to installation of the actual engine. First flight of this aircraft has not yet been scheduled.

The second X-15 will soon make its first powered flight. Two XLR11 engines will be substituted for the XLR99-RM-1 designed for the X-15 (AW Mar. 30, p. 59).

News Digest

Air Force Convair Atlas 14-D launched a heat sink nose cone about 5,000 mi. down the Atlantic Missile Range last week in the third successful test of recent fuel system modifications. One more test shot is scheduled, but the success of the first three is expected to lead USAF to launch an Atlas D within a few weeks from Vandenberg AFB to establish the initial operational capability originally scheduled for July 1 and delayed after a succession of Atlas test failures (AW July 6, p. 27).

Boeing Airplane Co. has consolidated its Seattle and Pilotless Aircraft Divisions and its Systems Management Office into a single new Aero-Space Division with Boeing Vice President Lyle A. Wood as general manager (AW April 27, p. 34).

Fairchild Engine & Airplane Corp. reported a first half net profit of $245,000, compared with a net loss last year of $5,003,000. Comparable sales were $60,399,000 this year and $67,801,000 last year.

Grumman Aircraft Engineering Corp. reported first half earnings rose to $3,826,601, or 84 cents a share, from $2,180,804 or 47 cents a share last year on a $23.9 million sales increase from $107,532,602 to $131,463,446.

Ryan Aeronautical Co. will design and build a Navy A2F-1 jet fighter tailpipe which will enable the plane to make "extremely short takeoffs and landings." Contract was awarded by Grumman.

Sperry Gyroscope Co. is developing one of the high-power radar transmitters to be used for target tracking in the Army's Nike Zeus anti-missile missile system under a $4 million contract with Bell Telephone Laboratories.

Army aviation officials this week will start evaluation of the Sikorsky S-60 flying crane under a contract calling for several weeks of evaluation at Ft. Rucker, Ala., Ft. Benning, Ga., and Ft. Bragg, S. C.

Gen. Minoru Genda, chief of staff of Japan's Air Self Defense Force, and a team of six officers, are in the United States for a two-month inspection tour to see the Grumman F11F-1F, Lockheed F-104, Northrop N-156F and Convair F-102 and F-106.

Folland Aircraft Managing Director W. E. W. Petter and Assistant Managing Director E. N. Egan will be leaving the company after its acquisition by Hawker Siddeley (AW Aug. 3, p. 30).

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Bilaterals Strengthen Foreign Carriers

BOAC, Air France gain round-the-world routes to meet competition from U. S. jet operations.

By Robert H. Cook

Washington—Foreign airlines are moving successfully to meet the competitive threat posed by the introduction of jet operations over the global routes of U. S. flag airlines by securing expanded traffic rights under the bilateral agreements their governments have with the U. S.

White House approval last week of a Tokyo stop for British Overseas Airways Corp. was the latest indication of what U. S. carriers fear may be a trend toward wholesale demands by foreign airlines for new routes to this country.

BOAC's authority followed on the heels of a new bilateral agreement expanding French traffic rights (AW Aug. 10, p. 39). Together, these route awards form the basis for two new round-the-world services to compete with U. S. carriers at a time when turbojet transports are just making such global service truly practical.

BOAC will take immediate advantage of its new authority by starting a global service Aug. 22 with two Britannia 312 turboprop flights a week between London and Hong Kong via New York, San Francisco, Honolulu and Tokyo. These flights will connect with the British carrier's Comet 4 turbojet service between London and Tokyo through the Middle East to complete the global service.

Air France will start biweekly service on its new polar route between Paris and Los Angeles next year after its Boeing 707-320 transports are delivered, and the French carrier plans to establish round-the-world service in 1961 when Transports Aeriens Intercontinentaux begins flying its Douglas DC-8s into Los Angeles over its new route from the South Pacific.

State Department Stand

Department of State officials, who say that a complete renunciation of the bilateral could have resulted in a loss of Fifth Freedom traffic rights for U. S. carriers flying beyond France, view the new French bilateral as a compromise favoring the U. S. They point out that France gave up its demands for "double track" routes, or duplication of every route granted U. S. carriers. The pact also fails to give the French the route they wanted most—access to the West Coast from New York.

While Air France has gained entry to the U. S. West Coast with a polar routing, an Air France spokesman emphasized the equal importance of extension of French routes from Tahiti to the West Coast via Honolulu. This Pacific route permits Transports Aeriens Intercontinentaux, a private French airline, to connect with Air France and provide the French with round-the-world service.

South Pacific Route

This South Pacific route is considered significant in view of French plans to develop Tahiti as a tourist center in competition with Hawaii. A new 12,000 ft. runway at Tahiti will be available for turbojet operations by early 1961 when TAI and Air France can establish their joint global service.

Air France will make a stop at Montreal when it begins operating the Paris-Los Angeles route with Boeing 707-320s. Meanwhile, Pan American World Airways plans to introduce turbojet service over its Los Angeles-Paris polar route by Aug. 26. This route also is served by Trans World Airlines and Scandinavian Airlines System, and BOAC and Lufthansa also have rights to fly it.

BOAC Reaction

A BOAC spokesman said the airline is "delighted to have approval at last" of its Tokyo stop but termed the four-month delay while awaiting White House approval "utterly incomprehensible."

BOAC estimated that the delay cost it $2.8 million in lost revenues. An airline spokesman said inaugural service over the route, minus a Tokyo stop, would not have been begun last March if BOAC had considered U. S. approval anything more than a formality. In addition to revenue losses, BOAC had to refund advanced fare bookings made over the Tokyo-San Francisco route.

The carrier also was forced to hold slip crews and their families idle at Honolulu throughout the course of negotiations between the two countries in expectation of a pending decision in the case.

As approved by the Civil Aeronautics Board, BOAC was authorized to provide three trips a week on the new route, but U. S. airline sources claim intervention by the Japanese government forced the British carrier to reduce its schedule pattern over the route to a twice weekly basis.

Japan Air Lines spokesmen say the airline has no plans to increase its nine weekly flights to this country as a result of the BOAC award. However, the carrier is negotiating for the lease of a Boeing 707-120 from Continental Airlines to meet competition from Pan American and BOAC (see p. 43). Pan American on Sept. 5 plans to inaugurate twice weekly jet services between Los Angeles and Tokyo and San Francisco and Tokyo.

Northwest Airlines, which fought the BOAC proposal, also says it has no plans to change its scheduling as a result of the addition of Tokyo to the British route.

However, the carrier is not convinced that the threat of direct competition with the British airline is past. While BOAC will fly a mid-Pacific route to Tokyo, as opposed to Northwest's routing on a Pacific polar route via Anchor-

707 Loses Nose Gear

Chicago—American Airlines Boeing 707-120 jet transport lost its dual nose wheels after a hard landing at O'Hare Airport last week. The jet transport skidded to a stop without apparent injury to any of its 92 passengers or eight crew members.

The airplane, landing in clear weather after a nonstop flight from Los Angeles, touched down hard about 400-500 ft. from the approach end of 8,800-ft. Runway 32L at O'Hare. It bounced about 50 ft. in the air, lost one nose wheel, and lost the other when it hit the runway again. The strut held up during the skid which ended 1,800 ft. from the end of the runway. Passengers deplaned via a normal loading ramp.

The jet had about 1,400 hr. of flying time and had completed a periodic check 14 hr. previous to the incident. Its pilot had over 200 hr. of 707 time. The plane was expected to be back in service in about three weeks.

707-420 Will Enter BOAC Service

First Boeing 707-420 intercontinental turbojet transport is the 35th 707 to be produced at Renton, Wash., by Boeing's Transport Division. The aircraft will enter British Overseas Airways Corp. service.

age, company attorneys claim that an Air Transport Agreement between the U.S. and Britain contains a clause allowing BOAC to use Anchorage as a fueling stop. This, they say, makes possible direct BOAC flights between Tokyo and San Francisco. Terms of the Bermuda Agreement, under which the route was spelled out, allows BOAC to drop any intermediate points, such as Honolulu and Wake Island, making a Pacific polar routing practical, according to Northwest.

Other U.S. airline spokesmen believe that the British carrier will divert a significant amount of traffic from both U.S. domestic and international carriers. More than 90% of the traffic potential BOAC may realize is Fifth Freedom traffic accounted for by Americans traveling to Japan. Tokyo, the spokesmen point out, represents 80% of the total transpacific air traffic and adding the city, along with New York and San Francisco, to the BOAC route gives the carrier three prime traffic gates not enjoyed by any single U.S. carrier.

Their fears were echoed by CAB member Louis J. Hector, who said that, although the Board discussed the public interest aspects of the BOAC request, the outcome of the issue was actually predetermined by the U.S. government's obligation to honor bilaterals.

Backing CAB Examiner Ferdinand D. Moran's rejection of the BOAC request, Hector said that although he concurred in granting the request he questioned much of the Board's reasoning in doing so. In essence he contended that, while the CAB conducts public-interest hearings on such matters under Section 402 of the Federal Aviation Act, such hearings are immaterial since the government already is bound to honor the route terms of its bilateral agreement.

Delta Proposes Low Coast-to-Coast Fare

Washington—Delta Air Lines has proposed a reduced fare "thriftcoach" service on a coast-to-coast schedule as one of its major plans for improved service if the carrier is granted West Coast routes in the Southern Transcontinental Service Case.

Testifying at Civil Aeronautics Board hearings last week, the airline said its plans also call for five daily turbojet schedules linking Atlanta and Miami with the West Coast and two daily all-cargo flights between these points with piston engine planes.

The airline has requested an extension of its present route system beyond Dallas, Ft. Worth and Houston to Los Angeles, San Diego and San Francisco. Delta also proposes to link San Juan, Havana, Caracas and other cities on its Caribbean routes with the California cities through a link-up at New Orleans.

Delta told the Board that it plans to offer 231 million thrift coach passenger miles in 1960 and expects a profit potential of $1.86 per plane mile on the planned service. Using DC-7s, in a combination of 67 thriftcoach and 18 first class seats, maximum passenger revenue per plane mile is expected to be $3.85.

Proposed thriftcoach fares would be about 3.87 cents per passenger mile, compared to current fares of 6.5 cents for first class and 5 cents for tourist service, the carrier said.

Based on an average trip length of 743 mi., Delta estimates the cost of the reduced fare service would run about $2.15 per plane mile, and breakeven passenger load factor would be 51.69%.

Cargo flights planned by Delta would use DC-6As on an initial schedule of two daily flights connecting Miami and Atlanta with San Francisco and Los Angeles, with additional schedules added as long haul traffic increased.

Braniff, Continental Report Profit Gains

Washington—Mid-year earnings reports of trunk airlines continue to register heavy gains, with Braniff Airways net income increased 107% over the first six months of last year, and Continental Airlines operating revenues reflecting a gain of 43% in the same period.

Braniff recorded a net income after taxes and capital gains of $1,805,888, based on operating revenues of $36,731,793 and total expenses of $33,468,314 for the first six months of this year.

In the same period of 1958, the carrier earned a net profit of $870,869 on operating revenues of $33,213,540 and expenses of $31,814,844. Depreciation and amortization costs during the 1959 period were $2,799,922, compared to $3,401,433 for the six month period last year.

Continental had a net income of $859,000 during the period, compared to a net loss of $383,000 for the first half of 1958. Operating revenues increased to $17,466,000, compared to $12,213,000 during the first half of last year, while expenses advanced from $12,377,000 to $16,584,000 in the same period. Much of the rise in interest and other expenses this year was canceled out by a net capital gain, after taxes, of $1,028,000 from the sale of aircraft.

First *electra/JET* service along the Pacific Coast

LATEST IN A 33-YEAR SERIES OF AIR TRAVEL "FIRSTS" is Western Airlines' new *electra/JET* service. Fastest and most comfortable flying ever between Seattle-Tacoma, Portland, San Francisco, and Los Angeles! The revolutionary *electra/JET* is big, powerful, *jet-fast*—and its combination of jets and propellers has some wonderful advantages over ordinary jets. The ability to take off and land more quickly... faster climbing to cruise altitude... greater nimbleness on the ground to cut taxi and loading time. As a result, the *electra/JET* is one jet whose gate-to-gate timetable really tells the truth! Now, more than ever, Western's the *wonderful* way to fly!

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WESTERN AIRLINES

Japan to Lease 707 for Pacific Jet Race

By Glenn Garrison

New York—Japan Air Lines is negotiating with Continental Airlines for the lease of one Boeing 707-120 jet transport to enter the Pacific jet competition, AVIATION WEEK has learned If the deal goes through as expected, the Japanese carrier could come close to matching the Sept. 5 transpacific inaugural date Pan American World Airways has set for its Boeing 707-320 aircraft.

Continental last week received its fourth jet, the final unit in its initial firm order. But the airline had optioned a fifth 707-120, and this airplane is off the production line and now is parked at Boeing's Renton, Wash., plant. It is fitted with a Continental interior and is in overwater configuration.

Japan Air Lines has ordered four Douglas DC-8 jet transports, the first of which is scheduled for May, 1960, delivery, and service with the airplane is expected to begin some time before July, 1960, (AW July 13, p. 39). But in the meantime, others in the turbine competition across the Pacific would gain a considerable lead on the Japanese carrier. Pan American expects to begin with two San Francisco-Honolulu-Tokyo and two Los Angeles-Honolulu-Tokyo flights a week and this schedule will extend through the winter season.

Northwest Orient Airlines has ordered five DC-8s for 1960 delivery and hopes to start service early next year. British Overseas Airways Corp. has announced plans to start transpacific schedules next Sunday with its Britannia 312 turboprop transports, which will connect at Tokyo with BOAC Comet 4 jets to provide a round-the-world turbine-powered service.

Continental Crews

AVIATION WEEK learned that initial use of Continental crews is contemplated. It is likely that Japanese crew members will be trained to at least partially replace the Continental personnel after the service gets under way. JAL now operates its piston-powered transpacific services partly with U. S. pilots (AW July 20, p. 39) and some U. S. first pilots probably will be used on initial DC-8 runs.

The Japanese airline now flies nine weekly round trips between the U. S. and Tokyo, most of them with Douglas DC-7C equipment and the rest with DC-6Bs. It serves the three Pacific Coast gateways of San Francisco, Los Angeles and Seattle.

Service with the Continental 707-120 would undoubtedly begin at Los Angeles or San Francisco, and possibly alternate between the two cities, with a traffic stop at Honolulu en route to Tokyo.

The lease with Continental probably will extend past the start of DC-8 service. Such an arrangement would add to JAL's jet capacity while its DC-8s were being phased in and would provide additional crew training opportunities. It appears likely from prestige considerations that all-Japanese crews will be flying the 707 as soon as practicable.

Previous Leases

If the JAL-Continental deal is consummated, it will mark the third instance of an airline, temporarily without jets, leasing aircraft to meet or beat its competition. First was National Airlines' deal with Pan American, giving National the use of 707-120s for the highly competitive New York-Miami run; and Northeast Airlines recently arranged to lease TWA jets for the same route next month (AW June 29, p. 31).

Continental's four delivered jets will be able to handle its needs for the immediate future, according to the airline. Since start of jet service, June 8, between Los Angeles and Chicago, Continental has carried about 30,000 passengers on the aircraft. It has been flying three nonstop round trips daily between the two cities, and was scheduled last week to add two more schedules, one with a stop at Denver and the other with a stop at Kansas City. On Sept. 5, the airline plans to add a second Chicago-Denver-Los Angeles schedule, for a total of six round trips daily between the two terminals.

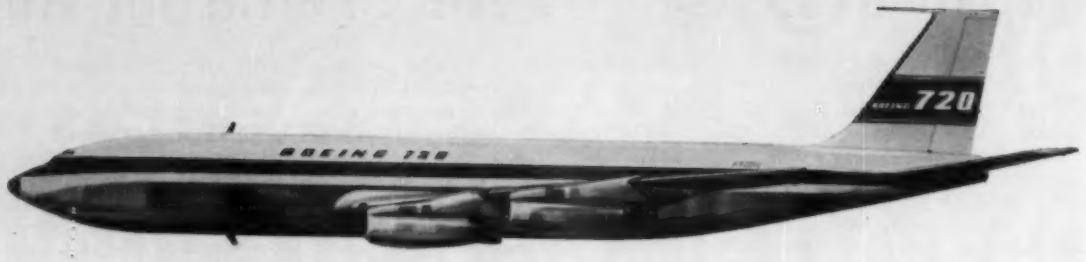
Continental has been averaging 11¼ hr. of daily utilization with its two jets in scheduled service. The fourth airplane will take over flight training duties, providing an active fleet of three.

The airline says its jet passengers, using Continental's new in-flight ticketing system (AW June 15, p. 38), are averaging 45 sec. through the check-in line at Chicago. Longest check-in, according to the carrier, took 2 min.

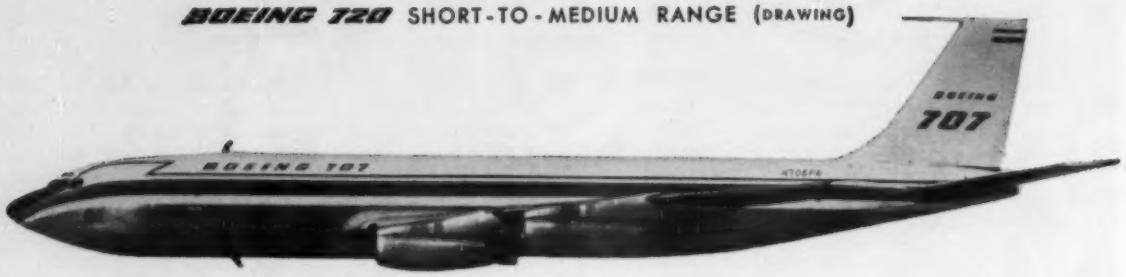
By Sept. 5, Continental will be operating more than 80% of its daily seat miles with turbine-powered equipment including the Boeing jets and 15 Vickers Viscount turboprops.

Boeing Tests Fifth Pod on Qantas Jet

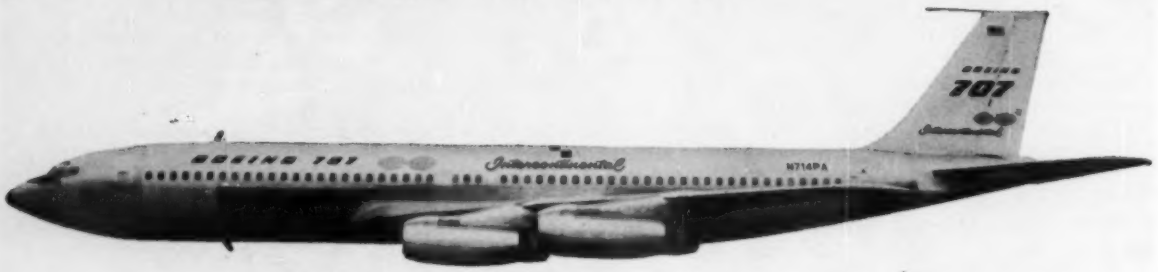
Qantas Empire Airways Boeing 707-120 jet transport, carrying its spare Pratt & Whitney JT3-C engine slung under its left wing in a fifth pod, takes off on a test flight from Boeing Field, Seattle, Wash. Boeing pilots said extra pod does not materially affect flight handling qualities. Aircraft is not a 707-420 as was previously reported (AW Aug. 10, p. 37). Below, Qantas "City of Canberra" flagship is shown on arrival at Honolulu, Hawaii, airport. Airline flies weekly jet service between Sydney, Australia, and San Francisco, Calif. Inaugural flight took 14 hr. 44 min. for 7,650 mi. route.



BOEING 720 SHORT-TO-MEDIUM RANGE (DRAWING)



BOEING 707 MEDIUM-LONG RANGE



BOEING 707 *Intercontinental* VERY LONG RANGE

Airline profit-makers

The Boeing jetliners shown above are designed for profitable operations over all airline routes, from short intercity segments to very long overocean stages.

Their outstanding earning power has already been demonstrated by the 707. Since going into service last October, this Boeing jet has attracted unprecedented load factors of 90 to 95%. Operators describe it as the most popular airliner in aviation history.

Within weeks the 707 Intercontinental—the world's longest-range jetliner—will begin commercial operations. With a range of more than 5000 miles with full passenger payload, it will fly nonstop over the longest stages of airline routes, at cruise speeds above 600 miles an hour.

The 720 is the fastest airliner of its class, with a cruise speed of 614 miles an hour. Backed by Boeing's unequalled multi-jet experience, the 720 is an extremely versatile jetliner able to operate profitably over short intercity and medium-range routes.

Boeing jetliners, now in scheduled service on United States and international routes, are demonstrating tremendous earning power, extremely high initial utilization and unprecedented public acceptance.

These airlines have already ordered Boeing jets:

AIR FRANCE · AIR INDIA · AMERICAN
B.O.A.C. · BRANIFF · CONTINENTAL
CUBANA · IRISH · LUFTHANSA
PAN AMERICAN · QANTAS · SABENA
SOUTH AFRICAN · TWA
UNITED · VARIG · *Also* MATS

BOEING
Family of jet airliners

Senate Approves $25 Million For MATS Jet Transport Fleet

Washington—Senate has tacked $30 million onto a supplemental appropriations bill to begin a comprehensive modernization program of Air Force's Military Air Transport Service.

Previously, both House and Senate had turned down Air Force's request for $53 million for 10 cargo jets for MATS in voting the Fiscal 1960 appropriation for Department of Defense (AW Aug. 10, p. 26). Air Transport Assn. fought the project, claiming MATS would use the jets in competition with commercial operations. However, USAF and its supporters on Capitol Hill apparently decided on another attempt after final passage of the defense bill.

The $30 million was approved after a brief presentation to a Senate Appropriations Subcommittee considering supplemental appropriations by Sen. Howard Cannon (D.-Nev.). Cannon reinforced his presentation with a letter from Air Force Secretary James H. Douglas supporting the measure.

As outlined by Cannon, the three steps in the MATS modernization:

- **First, "a high-speed alert force"** which would consist of two or three squadrons of Boeing 707, DC-8, or Convair 600 aircraft in a military configuration for efficient cargo handling. Approximately $25 million of the $30 million would be available for these cargo jets.
- **Second, a larger, faster,** long-range "workhorse" aircraft for cargo handling and troop transport. It would replace the piston-engine C-124, of which MATS now has 140. Cannon said the replacement would "very possibly be something like the C-130B." The additional $5 million in the $30 million bill is earmarked for the development of an advanced powerplant for the new workhorse aircraft.
- **Third, completion of the program** for the Douglas C-133 turboprop cargo aircraft now in the inventory. The programed build-up to 50 is scheduled to be completed in three years.

An ATA spokesman suggested that Air Force "dragged in" the $5 million for the workhorse cargo aircraft to gain support for the jet cargo aspect of its MATS modernization program, particularly the support of Sen. Mike Monroney (D.-Okla.). Monroney has been pushing for the development of such a plane for commercial as well as military cargo operations. Monroney estimates that, if an economical plane were developed which could operate for about 4.5 cents a ton-mile, about 300 of them could be used in commercial operations (AW May 18, p. 25).

In May, Assistant Secretary of Defense Perkins McGuire informed Monroney that Defense was working with the Federal Aviation Agency on the development of a commercial-military cargo aircraft.

Last week, after the Senate voted funds for USAF to undertake the development, Federal Aviation Agency Administrator Elwood Quesada canceled a scheduled press briefing on FAA's program for development of an economic commercial cargo plane.

At the subcommittee hearing, Monroney opposed placing control of the development with USAF. "I am certain, from the record that we have had in the past, that the Secretary of the Air Force, and none of his people, have ever been successful in designing or procuring a common type of cargo plane where the cost factor in day-to-day operations per ton-mile is the important element," Monroney said. "It is not the important element for the military, because they are seeking performance, and in getting performance they automatically get a lot of gadgetry, added equipment, built-in headwinds, and things of that kind."

Cannon reported that USAF has "several proposals" for the commercial-military cargo aircraft.

American Claims Revenue-Miles Peak

New York—American Airlines flew 559,854,000 revenue passenger miles last month, a total the airline said was an all-time monthly high for commercial aviation. The figure was about 20% higher than the July, 1958, total and, for the first time in American's postwar experience, the July total topped the June total. June usually is the airline's biggest traffic month.

Other increases were reported in air freight, up 10% over July of last year; air mail, up 15%; and surface mail, up 11%. American said its turbine fleet, now totaling 35 Boeing 707-120 jets and Lockheed Electra turboprops, was largely responsible for the July record.

American last week announced new expansions of its turbine aircraft services. By Aug. 21, when the new pattern is to be completed, plans call for new jet services which include two Dallas-Los Angeles flights daily, Boston-San Francisco service via Chicago, daily Chicago-Dallas round trips, and a second daily Baltimore-Los Angeles round trip.

New Electra services under the plan will include Chicago-Detroit flights, a Detroit-Chicago-Dallas-El Paso schedule, and an increase to nine daily round trips in New York-Chicago service.

Slick Places Order For Three 1049Hs

Slick Airways has placed an order with Lockheed Aircraft Corp. for three 1049H Constellation convertible cargo-passenger airplanes. Contract value is about $7 million, including spares. The first airplane will be delivered immediately; the other two will be transferred to Slick next month.

The move, according to Slick, is the first step in re-establishing the carrier in U. S. domestic air freight common carrier cargo service after temporary suspension (AW Mar. 10, 1958, p. 31).

Purchase of the 1049Hs brings Slick's total order for Lockheed planes to nine within one month. The line placed an order with Lockheed's Georgia Division for six Super Hercules freighters with a contract value of about $22 million (AW July 27, p. 53).

27 Airlines Bid For MATS Contracts

Washington — Twenty-seven commercial airlines have submitted bids to Military Air Transport Service for airlift of passengers and cargo to Europe, Alaska and the Pacific area during the year starting Oct. 1.

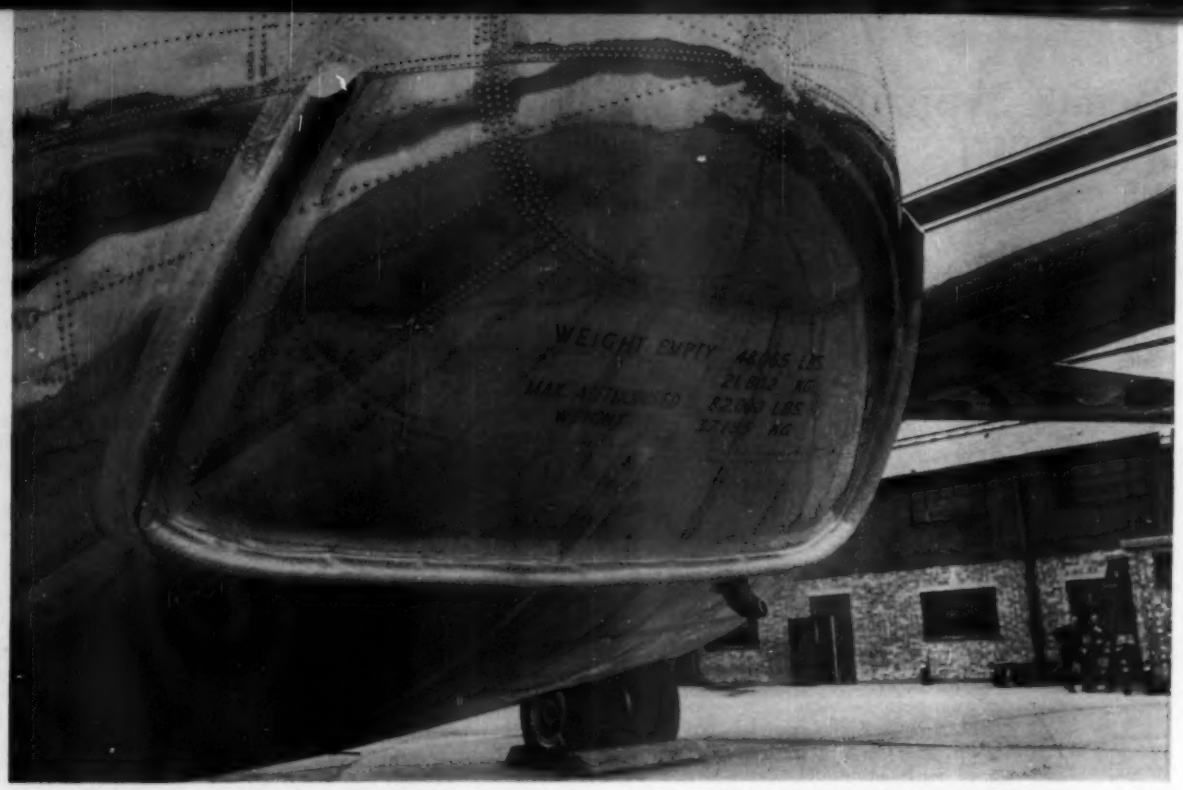
Considered by MATS the largest single military airlift purchase ever made, award of the contracts about Sept. 1 will cover airlift of 288,600 passengers, 10,320 tons of cargo and 6,144 tons of mixed traffic during the year. Commercial carriers will transport 129,000 passengers, 4,920 tons of cargo and 6,144 tons of mixed cargo in the Pacific; 123,600 passengers and 5,400 tons of cargo across the Atlantic; and 36,000 passengers in Alaska area.

Total of 87 operators which requested bid information for the airlift was the largest number ever to be placed on the military bidding list. Bid requirements were divided into 14 route segments.

BEA Signs Order for 24 Triple-Turbojet DH-121s

London—British European Airways contract for 24 Airco-de Havilland DH-121 jet airliners worth $87 million was signed last week. The airline holds an option for an additional 12 aircraft.

A 12-month contractual delay (AW Feb. 17, 1958, p. 41) was caused by specification changes reducing the size of the aircraft.



BREAKER STRIP around AW 650 rear fuselage dome prevents strong underside flow from causing turbulence on tail plane.

Argosy Modified to Cut Aft Turbulence

By John Tunstall

London—With one third of the Armstrong Whitworth AW 650 turboprop freighter development completed, virtually trouble free, designers expect full U. S. and British airworthiness certification by next March. This is two months ahead of a schedule prepared nearly two and a half years ago when the project was started.

Using the first four production aircraft, the company has logged 350 flying hours since the maiden flight six months ago. Only three flights out of a total of 361 were canceled for maintenance.

The only significant modification has been due to a flow breakaway along the upper surface of the fuselage, exciting low frequency vibrations in the rear fuselage and tail plane. The vibrations were barely perceptible at the rear of the fuselage and the company was originally undecided on need for correction.

Otherwise, Deputy Chief Engineer David Woodley told AVIATION WEEK, modifications have been minor, and the behavior of the aircraft systems which have been fully installed in all four aircraft has been good.

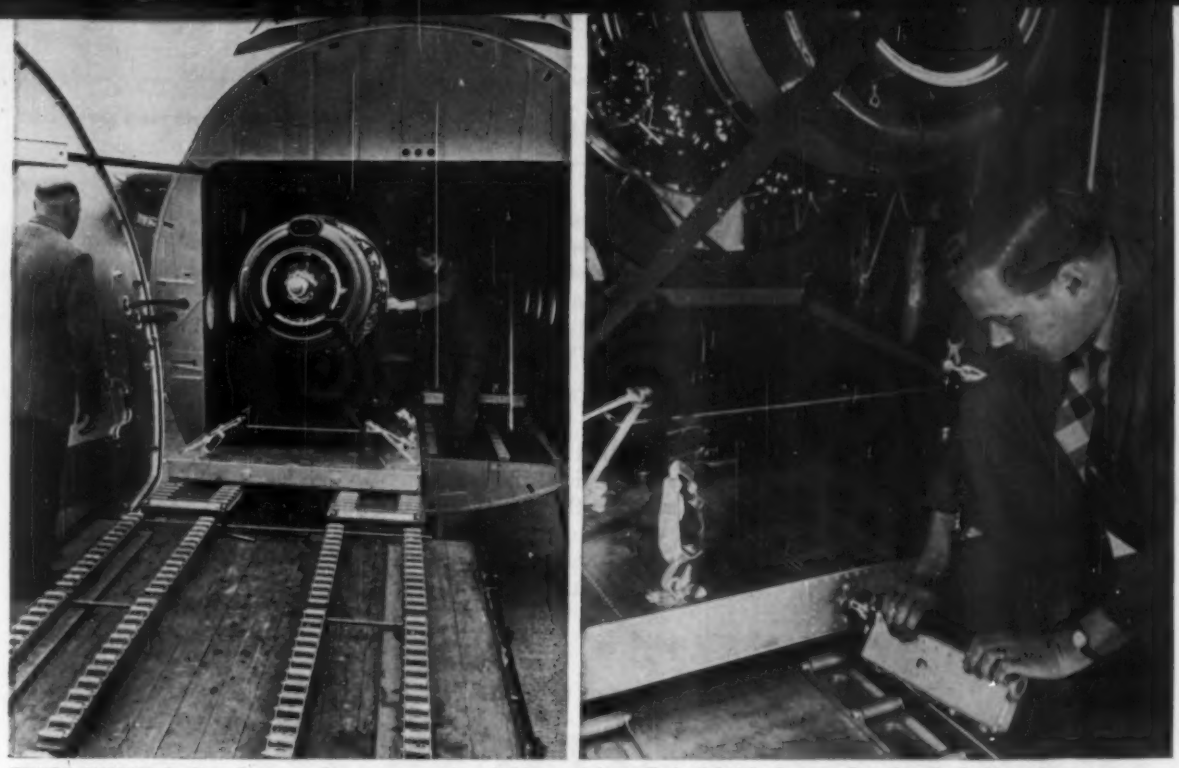
TWO MEN can load palletized freight in a short time, aided by roller strips on flooring.

Cockpit Slope

Breakaway of the top fuselage flow is due, Woodley said, to the relatively steep downward slope of the cockpit rear and to the high wing position. Also, the fuselage in a twin boom configuration was particularly susceptible to vibration, due to buffeting produced through lack of the damping influence of an integral empennage.

Because of the broken top flow, the strong undisturbed pressure flow along the bottom of the fuselage is able to sweep upward and direct the turbulent wake on to the tail plane. The excitation is dependent on speed and appears to be in the 7-30 cps. band.

Current attempts to improve the flow include vortex generators on the rearward slope of the cockpit blister and a breaker strip around the lower part of the fuselage and dome which impedes upward flow from the bottom fuselage surface. The fifth aircraft currently is being fitted with a larger wing



TRUCK HEIGHT loading floor speeds cargo operation (left); at right, palletized freight is secured to floor by locking pieces.

fillet which may be able to replace the breaker strip.

In the basic airworthiness phase of the test program which has now been concluded, all the systems have been cleared, and the aircraft has flown at maximum weights over its full center of gravity range. Docility of the 82,000 lb. aircraft is pointed up by its ability to hold 75 kt. with full flap, landing gear down and one engine feathered.

The company is now proceeding with the detailed evaluation of performance criteria.

Tropical trials are due to start in September.

In the static test program, all the critical loading cases have been covered, and fatigue testing now under way on a complete aircraft in the water tank has logged 5,000 hr. of simulated flight. Production is now one aircraft a month.

Following acceptance of a restricted certificate of airworthiness in May, Armstrong Whitworth has been using the fourth production aircraft for demonstration flights to airlines and for freight handling exercises. Fitted out as a mixed passenger/freight variant with seating for 18 passengers, it will later be used for route-proving trials. Seats which fold flat against the sides and removeable bulkheads enhance the rapid convertibility of layout.

Company's palletized freight system is based on use of lightweight metal strips mounting small rollers which are bolted to the freight floor. Pallets can be stressed, unstressed or box type. Company studies, Woodley claimed, proved that the added weight of the palletizing equipment is amply justified by the flexibility and increased loading rates obtained.

Argosy sales tour of the U.S. is scheduled for early 1960. Company now has expressions of intent for about 40 aircraft, but no signed contracts.

Riddle Airlines has ordered four AW 650s, with Rolls-Royce Dart engines (AW June 22, p. 112).

Company is negotiating with British Ministry of Supply for a military order of about 12 aircraft and envisions future development of up to 110,000 lb. gross weight.

VORTEX generators (left) are installed on cockpit blister to help eliminate buffeting at rear. At right is AW 650 cockpit layout.

U.S. AIR FORCE LOGISTICS SUPPORT

The man:

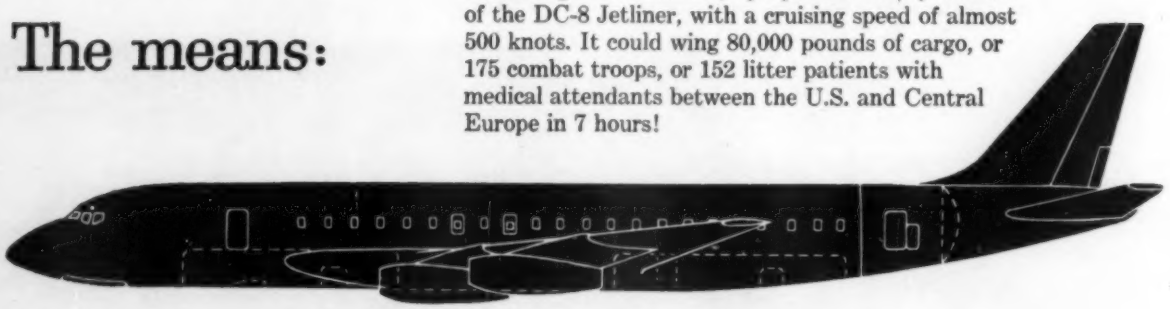
A member of an Army Medical Corps air evacuation team. He belongs to one of the Army units which rush the sick and wounded to general hospitals by air. Fast evacuation of casualties to hospitals has dramatically reduced the number of fatalities in "brush fire" or general warfare.

The mission:

In addition to its priority mission of supporting the strategic striking forces, Military Air Transport Service also has the humanitarian mission of air evacuation—high-speed movement of wounded from base hospitals in the theatre of operations to the finest stateside medical care.

The means:

The Douglas "Jetmaster," proposed military version of the DC-8 Jetliner, with a cruising speed of almost 500 knots. It could wing 80,000 pounds of cargo, or 175 combat troops, or 152 litter patients with medical attendants between the U.S. and Central Europe in 7 hours!



Depend on **DOUGLAS**

The Nation's Partner in Defense

Airline Traffic—June, 1959

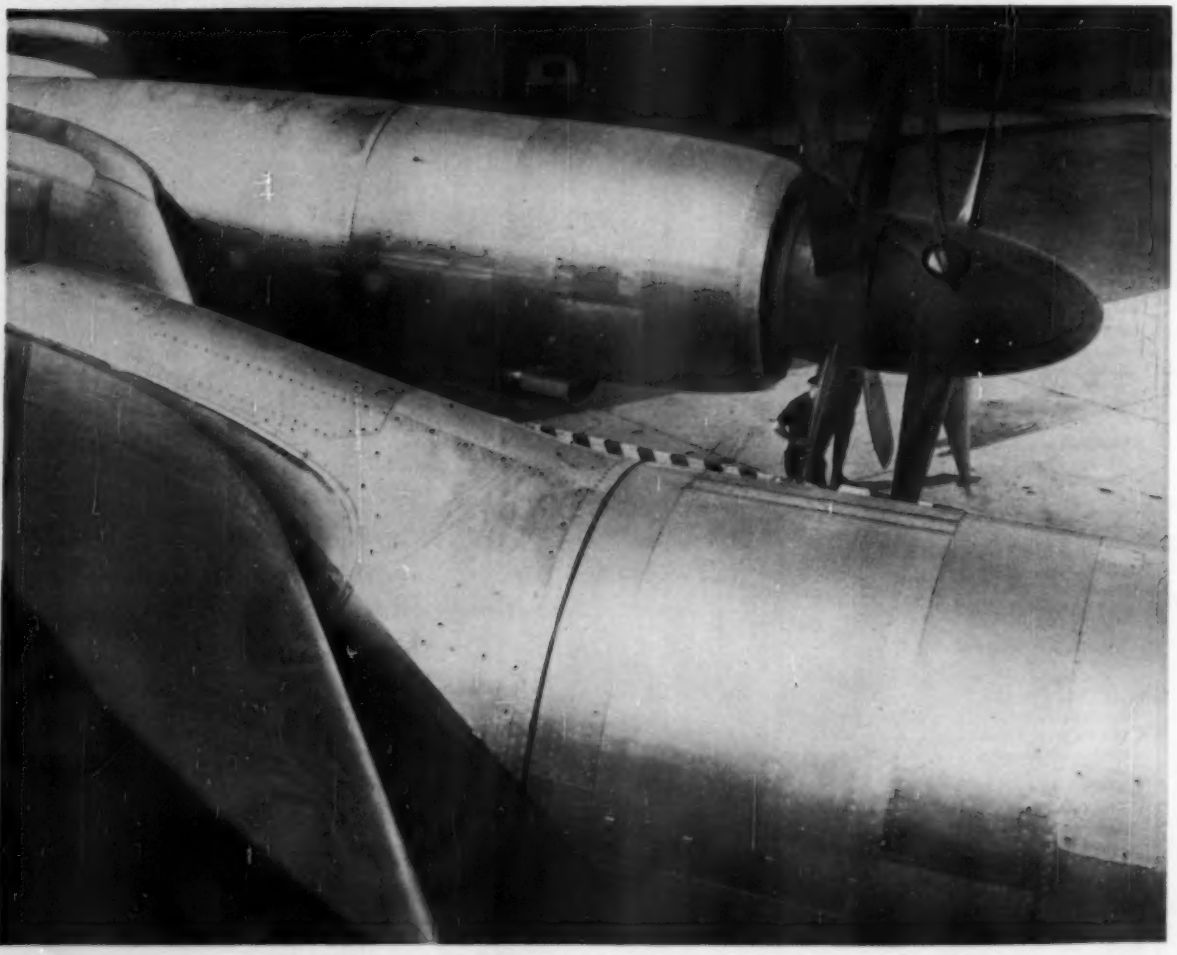
	Revenue Passengers	Revenue Passenger Miles (000)	Load Factor %	U. S. Mail	Express	Freight	Total Revenue Ton-Miles	% Revenue to Available Ton-Miles
DOMESTIC TRUNK								
American	709,949	541,558	80.6	1,716,928	844,274	8,625,687	63,179,285	66.6
Braniff	177,149	80,425	61.7	329,280	172,744	697,542	8,917,969	51.7
Capital	355,145	145,290	62.2	448,731	257,601	412,352	15,039,318	54.8
Continental	100,582	60,631	64.5	124,667	52,894	167,660	6,159,333	54.7
Delta	262,024	132,400	59.7	386,688	288,455	1,205,982	14,627,653	53.9
Eastern	723,501	384,725	53.35	981,042	506,133	1,431,233	39,960,237	43.47
National	134,928	80,077	54.5	255,559	63,987	525,261	8,566,078	44.5
Northeast	109,442	41,881	50.7	81,710	34,314	106,373	4,230,640	40.8
Northwest	174,535	137,245	64.5	523,872	255,808	1,241,041	15,203,244	54.8
Trans World	477,467	441,389	80.3	1,253,656	647,294	2,514,308	46,703,089	67.5
United	673,849	498,650	75.2	2,692,130	1,014,775	6,668,420	58,191,346	65.6
Western	134,997	77,624	60.6	271,755	80,264	364,843	8,152,204	52.5
INTERNATIONAL								
American	9,873	9,573	60.3	10,568	452	244,368	1,244,382	64.0
Braniff	4,440	8,156	57.2	24,249	.....	125,100	1,037,933	53.2
Caribbean-Atlantic	24,348	1,691	63.0	1,743	.....	4,623	183,805	69.2
Delta	4,555	6,071	55.2	6,577	.....	52,363	735,451	49.4
Eastern	38,620	56,346	59.90	75,922	.....	104,713	5,984,326	74.66
Mackey	9,557	1,823	45.7	.....	76	2,280	198,971	45.6
National	6,932	4,548	56.0	8,306	4,714	44,243	541,004	50.2
Northwest	20,505	39,096	63.5	1,176,382	26,191	965,297	6,281,322	67.8
Pan American								
Alaska	5,916	6,232	66.2	43,787	.....	181,838	899,391	64.8
Atlantic	122,582	189,712	76.9	1,338,112	.....	2,824,994	23,987,382	66.6
Latin America	115,259	133,565	71.2	391,729	.....	4,156,432	17,179,463	66.9
Pacific	29,897	119,294	83.3	1,245,792	.....	1,944,250	15,638,671	75.6
Panagra	10,034	14,277	55.5	61,196	.....	464,249	2,077,745	57.5
Resort	20	31	19.8	.....	.....	4,336,431	4,344,161	79.5
Trans Caribbean*	.....	.....	.....	.....	.....	.....	.....	.....
Trans World	39,894	126,572	75.1	741,470	.....	1,922,913	15,671,171	71.4
UMCA	126	41	30.6	.....	.....	1,110	5,445	36.7
United	14,071	34,956	84.5	163,256	.....	128,279	3,864,968	80.4
Western	4,294	6,677	61.6	12,560	.....	10,997	750,938	64.5
LOCAL SERVICE								
Allegheny	55,505	9,863	53.2	11,570	21,494	27,723	1,002,433	52.3
Bonanza	19,627	4,820	45.6	5,856	2,423	10,316	480,097	43.9
Central	14,619	2,797	38.1	7,593	3,460	11,799	290,772	34.6
Frontier	26,238	6,782	44.1	21,358	10,686	72,146	757,153	51.7
Lake Central	20,163	3,250	45.6	3,809	.....	18,609	333,587	49.3
Mohawk	51,026	10,078	57.9	8,324	17,768	15,730	1,003,398	57.6
North Central	88,862	16,088	47.0	33,332	48,133	17,016	1,663,372	46.92
Ozark	51,392	8,890	46.7	13,959	25,956	28,146	917,766	48.9
Pacific*	.....	.....	.....	.....	.....	.....	.....	.....
Piedmont	45,624	9,725	47.1	17,612	14,127	17,411	981,267	48.1
Southern	22,743	4,015	40.0	10,093	9,429	15,127	419,437	40.5
Trans-Texas	24,279	5,751	42.5	17,019	9,321	34,222	610,534	43.3
West Coast	29,343	5,546	51.64	5,725	2,303	8,499	546,119	51.54
HAWAIIAN								
Aloha	28,549	3,999	60.8	2,197	.....	7,811	331,447	43.2
Hawaiian	43,530	14,885	76.0	3,822	.....	136,469	1,481,072	74.1
CARGO LINES								
AAXICO	.....	.....	.....	4,283	8,637	2,787,081	2,800,001	75.72
Aerovias Sud Americana*	.....	.....	.....	.....	.....	.....	.....	.....
Flying Tiger	3,124	14,803	100.0	42,414	64,762	12,354,979	13,942,497	86.8
Riddle	.....	.....	.....	.....	.....	.....	.....	.....
Domestic	.....	.....	.....	7,716	19,581	3,909,305	3,936,602	74.7
Overseas	.....	.....	.....	.....	.....	472,681	472,681	66.0
Seaboard & Western*	.....	.....	.....	.....	.....	.....	.....	.....
Slick	3,791	24,380	99.16	.....	.....	.....	.....	99.16
HELICOPTER LINES								
Chicago Helicopter	20,130	367	58.9	1,385	.....	.....	36,415	51.4
Los Angeles Airways	4,417	152.6	59.4	4,895	2,305	.....	21,789	65.8
New York Airways	13,125	240	61.2	1,560	1,087	600	26,204	55.2
ALASKA LINES								
Alaska Airlines	10,834	9,860	69.5	43,664	3,074	759,262	1,783,828	62.4
Alaska Coastal	6,479	688	57.1	3,400	.....	4,898	78,156	59.9
Cordova*	.....	.....	.....	.....	.....	.....	.....	.....
Ellis	6,145	363	51.9	2,266	.....	3,714	42,688	61.07
Northern Consolidated	3,410	1,164	48.6	31,104	.....	92,560	249,804	63.3
Pacific Northern	14,343	14,583	63.1	112,535	9,057	349,002	2,049,671	72.1
Reeve Aleutian	2,108	1,896	53.3	37,997	.....	78,183	321,161	63.8
Wien Alaska	5,581	1,932	37.8	50,100	.....	371,704	617,584	66.2

* Not available.

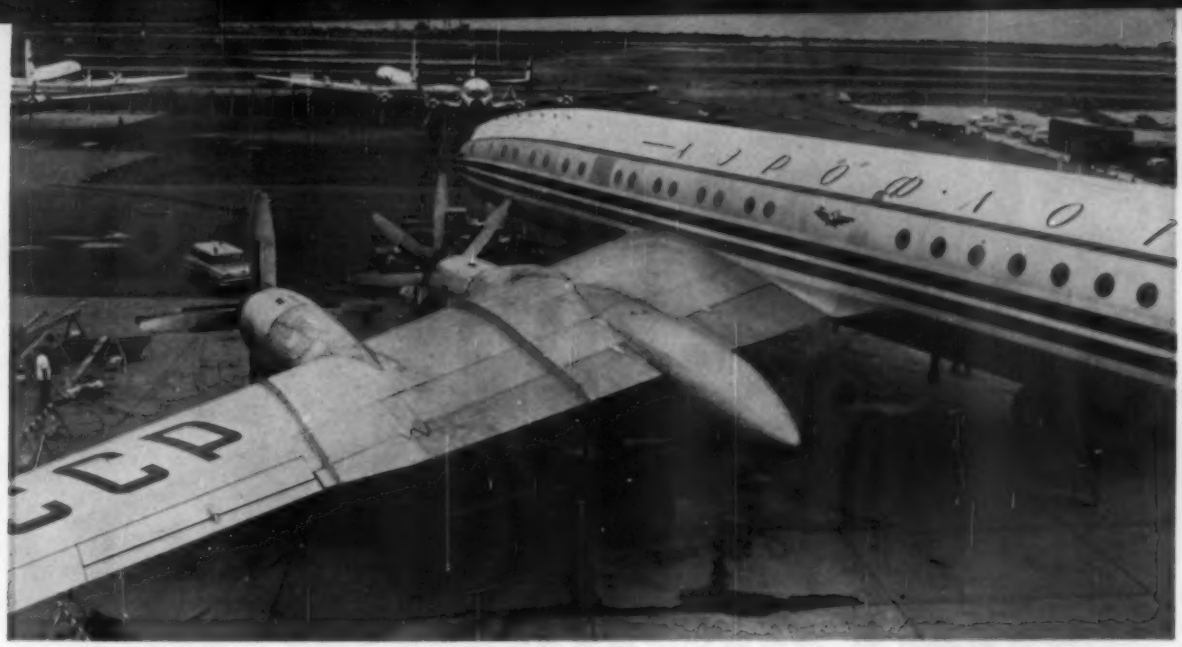
Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

BEING TOWED to taxiway at N. Y. International Airport for engine runup, Tupolev Tu-114 shows clean cross-section in rear view, marked negative dihedral of its swept wings. Huge size is apparent when compared with personnel walking turboprop transport to taxiway.

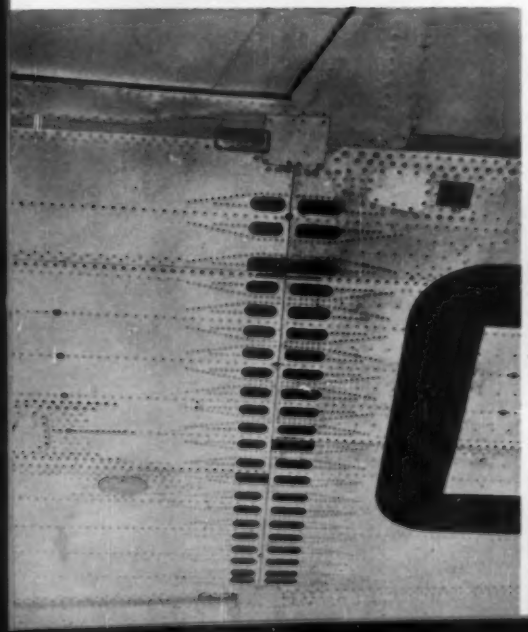
Design Details of Aeroflot Tu-114 Turboprop

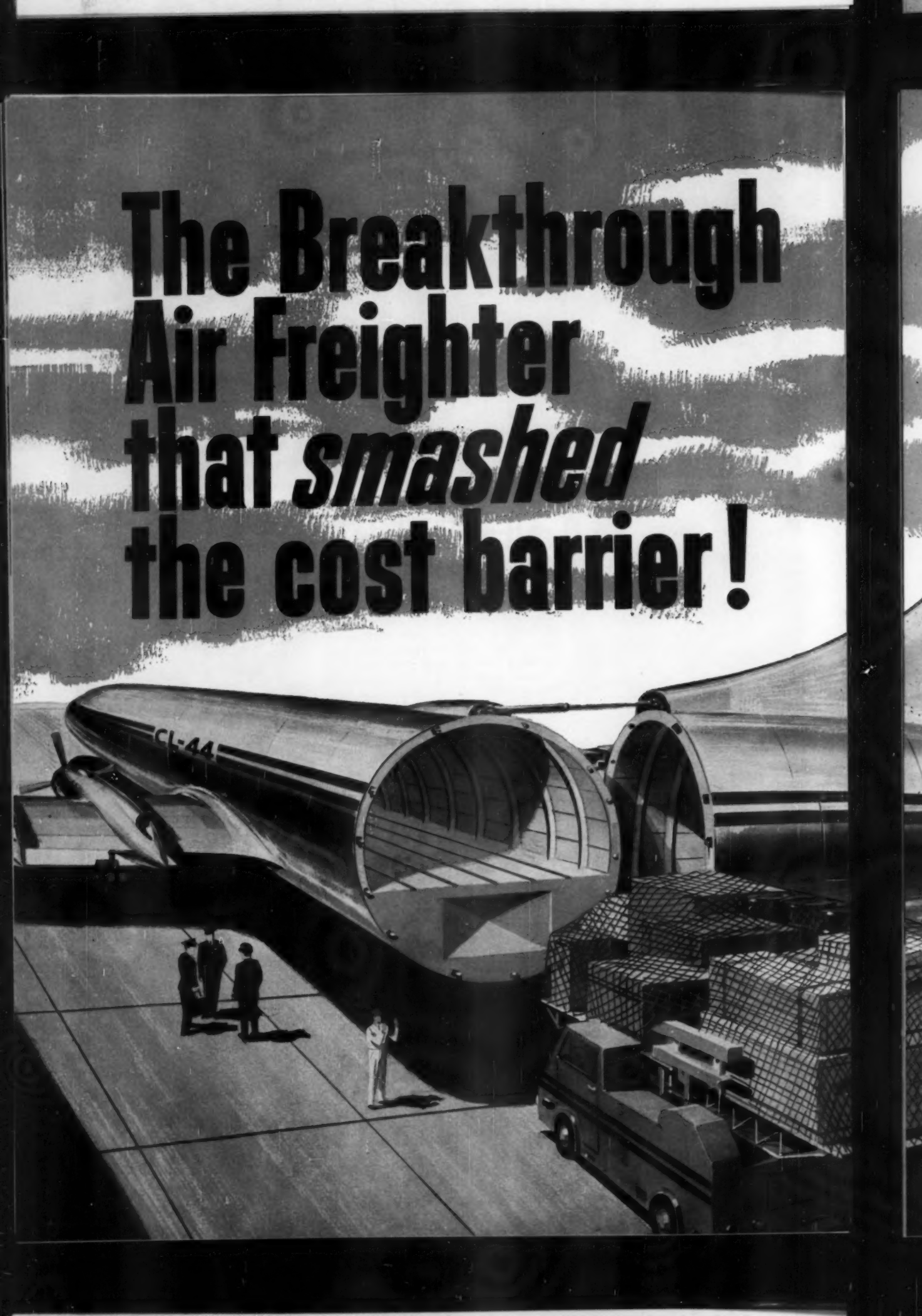


CLOSELY COWLED Kusnetzov axial-flow turboprops develop well over 12,000 shp. each, according to the Russians, and use JP-1 type fuel and synthetic lubricants. Hubs of 18.3-ft. diameter reversible contrarotating props are cleanly faired into spinners. Propellers apparently have no brakes, since a pair was observed turning, lashed together, when a breeze sprung up suddenly.



LARGE inner engine nacelle (top) houses huge four-wheel main gear which is retracted using two big electric motors in each well. Gear describes half-circle in retraction cycle, according to Russians. Nose gear (left) is hydraulically retracted, as is twin-wheel tail-bumper. Russian engineers make up gear struts from several components, weld them together, rather than spend time designing single-piece unit. Thin vertical member between fork was welded just above U-fitting. Closeup (right) shows main landing gear truck, facing forward wheels, detail of wheel axle. Chordwise wing splice (lower left) is located between aileron. Fairing strip narrows gap between wing and flap (upper left). Extensive riveting is used throughout Tu-114, rather than spotwelding or honeycomb bonded structures. Tail assembly (lower right) features movable horizontal stabilizer, markings indicating travel were on left side only, just ahead of stabilizer leading edge. Control surfaces are fitted with hydraulic boost system.




The Breakthrough
Air Freighter
that *smashed*
the cost barrier!
CL-44

CANADAIR JET-PROP CL-44

...the first aircraft designed specifically for the air cargo industry

The jet-prop CL-44 was designed specifically to meet the immediate requirement for an aircraft that would significantly lower the cost of cargo movement.

In this highly important role, the Canadair CL-44 breaks through the transportation cost barrier and will revolutionize the whole air cargo market. It provides direct operating costs of less than 4¢ a ton mile and breakeven load factors as low as 28%, which are both lower than those of any other aircraft anywhere in the world.

The swing-tail CL-44 is already in production for the largest air cargo carriers in the world—Seaboard & Western Airlines Inc. and The Flying Tiger Line Inc.

- Payload—64,000 lbs. • Range—3,000 mi. • Speed—400 mph
- Engines—4 Rolls-Royce Tyne 12 • Cubic capacity—7,391 cu. ft.
- Floor loading—300 lbs. per sq. ft. • Passengers—up to 183
- Span—142 ft. • Length—138 ft. • Cabin length—98 ft.
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The Canadair CL-44 is also available as a passenger or as a convertible passenger/cargo aircraft.

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AIRLINE OBSERVER

► Watch for Iberia Air Lines of Spain to announce the purchase of at least three turbojet aircraft within the next few weeks. Probable order will be for Douglas DC-8s, although the company also has been looking at both Boeing and Convair jets. Order would be placed by the National Institute of Industry, owner of the airline, and is reported awaiting the official backing of Spain's Council of Ministers. The aircraft would be used to meet expected jet competition from both European and South American operators and would be placed on Iberia routes to New York, Mexico City and the Caribbean.

► **Hawaiian Airlines has signed a credit agreement for $3.25 million that will permit the airline to complete its re-equipment program with the purchase of four additional Convair 340 aircraft. The company, which now operates four Convair 340s, seven Douglas DC-3s and one Douglas DC-6C, plans to phase out the DC-3s within the next two years. Terms of the agreement call for loans of $750,000 each from the Bishop National Bank and the Bank of Hawaii, with the $1.75 million balance to be provided by the First National City Bank of New York. Loan is scheduled to be retired by Dec. 31, 1965, and was obtained without a guarantee from the Civil Aeronautics Board.**

► Trans-Canada Air Lines has completed installation of airborne weather radar on its fleet of 50 Vickers Viscounts and 13 Lockheed Super Constellations. Cost of the refit program, which began last September, is estimated by TCA at $1.5 million, with Bendix and RCA radar units costing between $10,000 and $11,000 each. Modification and installation expense for each aircraft is about $15,000.

► **Two trunk airlines have introduced commuter ticket plans on an experimental basis and may expand the new service if it proves successful. Capital Airlines last month put its first commuter ticket books on sale, effective Aug. 2 over its Chicago-Minneapolis-St. Paul route. By the time the service began, the airline had sold $125,000 worth of commuter tickets, according to Walter H. Johnson, senior vice president of marketing. American Airlines' first commuter tickets were scheduled to become effective last Saturday over the Boston-New York-Washington route. They will be good for seats in either direction. Each airline sells its commuter tickets in books of 10. Holders of the tickets book space by telephone and write flight number, date of departure and time information—or, in Capital's case, a code number—on the flight coupon. This ends the transaction until the passenger surrenders his coupon upon boarding his flight. Johnson said Capital may extend the commuter service to the New York market within the next 30 days. He said the plan was in line with Capital's intention "to make air transportation easier to use and more convenient to buy." American expects to evaluate the results of its commuter service at the end of October and then possibly apply it to other cities.**

► Continental Airlines is providing free bus transportation between Chicago's Midway Airport and O'Hare Field for interline passengers connecting with the company's Boeing 707-120 flights between Chicago and Los Angeles.

► **Vickers-Armstrongs, Ltd. says U. S. operation of Vickers Vanguard turboprop transport could bring an airline a potential profit of $6.5 million annually per plane. The British manufacturer bases its profit picture on U. S. costs over 300-mi. stage lengths, a beginning load factor of 48.5% by 1962 and attainment of an 86% load factor by 1968. Applied to European routes, Vickers says the Vanguard would earn a per plane profit of more than $19 million in the same seven-year period.**

► British European Airways' net profits for Fiscal 1958-59 dropped more than $1.25 million from the previous year and totaled about $644,000, according to a preliminary financial report by BEA chairman, Lord Douglas of Kirtleside. Profits before paying interest charges on capital were about $3.6 million. Passenger traffic for the first quarter of the current fiscal year, however, was up 22% above that for the same period of last year.

SHORTLINES

► **Air Express Division** of the Railway Express Agency reports that it handled 2,945,724 shipments on U. S. scheduled airlines during the first six months of 1959, 15.9% above that for the same period last year. Revenue for the period was up 20%—$22,398,438 as compared with $18,666,780 for the first six months of 1958. Ton-miles totaled 26,659,618, a 22% gain over the 1958 period.

► **Allegheny Airlines** carried 58,797 passengers over 10.2 million revenue passenger miles during July, a 27% increase for the latter over July, 1958. Air freight and express boardings totaled 557,000 lb., with air freight up 36% over July, 1958.

► **Maritime Central Airways** is now operating a Vickers Viscount V. 805 turboprop transport on its Moncton, New Brunswick-Goose Bay, Labrador, and Gander-St. John's, Newfoundland routes. The airline plans to use a combination freight passenger configuration on the flights.

► **Mexicana Airline (CMA)** is scheduled to begin Bristol Britannia nonstop service between Los Angeles and Mexico City on Sept. 1. The Britannias will operate on Wednesdays, Saturdays and Sundays, with CMA's Douglas DC-6 aircraft operating on the other four days of the week.

► **Mohawk Airlines** carried 47,118 revenue passengers in July for a 30.2% increase over July, 1958. Load factor for the month was 53.1, a 6.1% increase over July, 1958.

► **Northwest Airlines** flew 165,718 domestic passengers 130,128,649 revenue passenger miles during July for 16.5% and 18.6% increases respectively over the same month of last year.

► **Seven Seas Airlines,** recently organized under authorization of the Federal Aviation Agency to operate contract air service on a world-wide basis, has purchased two Douglas DC-4 aircraft. The carrier, which was incorporated in June, has offices in New York and Amsterdam. Seven Seas purchased the DC-4s from Twentieth Century Aircraft, Inc.

► **United Air Lines** has begun Chicago-Milwaukee daily round trip service using Convair aircraft. The carrier also has inaugurated Douglas DC-7 daily through-service from both Philadelphia and Pittsburgh to Las Vegas; a nonstop DC-7 service from Salt Lake City to San Francisco and daily one-stop DC-7 service from San Diego to Chicago.

SYMBOL OF A NEW SERVICE TO AVIATION

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Simulators Train Mercury Space Pilots

By Craig Lewis

Langley Field, Va.—Mercury capsule pilots will use a variety of simulators and simulation techniques to gain practice with the equipment they will use and become familiar with the conditions they will meet when they make the first manned U.S. orbital flights through space.

National Aeronautics and Space Administration's Space Task Group will be putting the Mercury pilots through a number of simulation systems and techniques here at Langley Research Center and elsewhere to familiarize them with the Mercury capsule and its operation. Pilots also will acquaint themselves with those space conditions which can be simulated on earth.

Basic Element

Simulator work is a basic element in the intensive training and indoctrination program the seven Mercury pilots began in April (AW May 18, p. 30) to prepare them for the first U.S. launching of a man into orbit, probably in 1961. Mercury pilots are now moving into the initial stages of the simulator elements of the program.

Using standard computer simulation techniques, Space Task Group has developed a closed loop analog simulation of the Mercury mission, and this is the first system to be used in the training program. Early version of the simulator includes a chair, sidearm controller and rudder pedals, a configuration similar to the X-15 control system simulator. The Mercury system is isolated by canvas curtains.

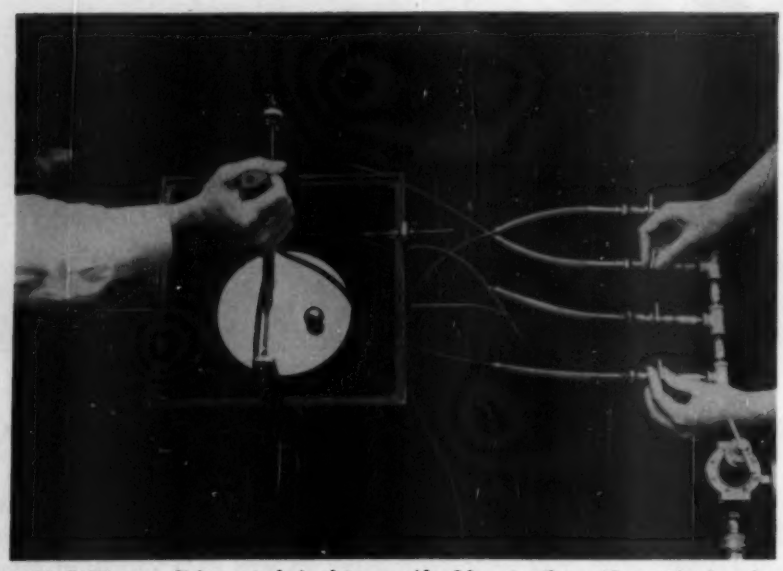
Pilot will be active as part of the closed loop system, and various displays and controllers will be tested during the program. Later version will have a moulded couch of the type to be used in the Mercury capsule and will be equipped with a three-axis controller.

This simulator is limited in its analog capability and cannot run a continuous flight cycle for the pilot. It can simulate re-entry, for example, only at discrete points. Although the complete Mercury mission cannot be animated, the orbital phase, retrograde firing mode and re-entry phase can be simulated, and the pilot can be moved from one to another by some quick switching in the computer system.

Since the simulator is a static device, no dynamic motions can be introduced and work is confined to flight control coordination and evaluation of control system and displays. There is no capability for introducing emergencies into the system. More advanced simulation, including some dynamic aspects of the Mercury mission, will be encountered during the sessions this month and next January in the Navy's centrifuge at Johnsville, Pa. Computer-run centrifuge simulator will have the basic Mercury instrument panel with attitude, rate, altitude and acceleration instruments animated. It will have the Mercury couch and the present version of the restraint harness, and it will also have the current production type hand controller.

McDonnell Aircraft Corp., the Mercury capsule prime contractor, is responsible for the controller design. It will be a three-axis type in which the pilot controls yaw through the palm of his hand by moving the controller left or right, pitch through his wrist by moving the controller back or forward, and roll by twisting his hand left or right around a pivot point three inches below his hand.

This three-axis controller is a departure from the usual aircraft control system, and it has been suggested that the Mercury pilots might do better with yaw control in the pedals they are familiar with from aircraft operation. Space Task Group expects the pilots to accept the three-axis controller as a superior system once they get some practice with it in the simulators.

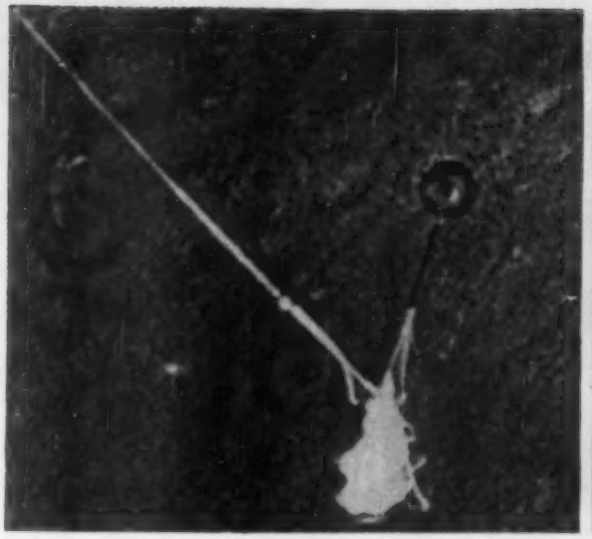


BALL DISK space flight control simulator provides Mercury pilots with practice in using control systems with no damping and no spring response. Pilot grasps handle and maneuvers the disk to keep the freely rolling ball centered on it. Air jets can be used to blow the ball across the disk to simulate motion when retrorockets are fired on the Mercury capsule. Reactions required to keep the ball centered on the disk are similar to those used to keep the earth image centered in the Mercury periscope.

Launch Acceleration Pattern

In the centrifuge, the launch acceleration pattern will be run open loop since there will be no pilot control function during the actual Mercury launch. There will be no dynamic motion in the retrograde maneuvering simulation because there are no large accelerations involved. In this phase, the Johnsville simulator will be a closed loop analog system much like the simulator at Langley. Centrifuge will be used in the re-entry phase, and accelerations will depend to a limited degree upon pilot control, although there is not much change in acceleration vectors possible with the Mercury capsule during re-entry.

Simulation at Johnsville will include some escape maneuvers and re-entries following aborted missions. Accelerations on the order of 20g are the highest expected in the Mercury mission, but the pilot will not necessarily reach that level in training. Space Task Group wants to avoid chances of injuring the pilots, and the higher accelerations will be used only if they



C-119 Recovers Discoverer Payload in Test

Parachute of General Electric payload for the ARPA-Lockheed WS-117L Discoverer satellite is snared by a cable trailing from a Fairchild C-119 during practice tests of air recovery of the unit after it has been ejected from orbit. In tests, the payload is dropped from another aircraft. In the picture at right, winch system pulls the capsule into the C-119's bay.

definitely have training value, according to Harold Johnson, chief of the training devices section of STG's Operations Division. Some acceleration forces will be used to check out the harness with the Mercury pilots.

The training exercises in the early simulator here at Langley are largely for engineering evaluation of the system, the controllers and the displays. The work at Johnsville will have this function, but it also will provide the pilots more realistic familiarization with the Mercury system. The January session at Johnsville will be generally the same as the August program, except it will be somewhat more sophisticated, probably with more capability for simulating aborts and with added emphasis on the Redstone-boosted training flights the pilots are scheduled to make.

An air bearing orbital attitude simulator will be used at Langley to train the pilots in attitude control during orbital flight. This iron-cross type simulator uses an air bearing to eliminate friction and to give the pilots some realistic practice with the reaction jet system they will use to control attitude.

In this simulator, the pilot lies on his back in a Mercury couch. A wide angle lens and mirror system are used to project an earth model picture in a simulation of the Mercury periscope system. The pilot will use this horizon picture to practice attitude control and to acquire some navigational training.

McDonnell is scheduled to build a series of trainers in the actual capsule configuration, using Space Task Force specifications. Two similar trainers will have faithful reproductions of the Mercury cockpit. One will be used as a procedures trainer, and the other will be given analog capability. The more sophisticated crew trainer will have animated instruments and possibly a periscope display mockup. It will have more capability for simulating a real time mission.

Environmental trainer will be a simplified capsule with prototype environmental equipment to familiarize the Mercury pilots with the operation of this key system. Trainer will have a simple fault insertion capability. Initial work with the environmental equipment will be done at sea level pressure, and the simulator will later be put in a vacuum chamber.

Post-Landing Training

Escape and recovery trainer will deal with conditions the pilots will meet after landing. It will cover the use of recovery equipment, getting out of the capsule in various sea conditions and removing and using the raft. The trainer will have all the internal impediments the pilot must contend with in leaving the capsule, and it will have the same center of gravity as the Mercury capsule so that it will behave the same in water.

Training will take place with the escape and recovery simulator in the water. It will be done wherever the necessary sea states can be found, including swimming pools, rivers, Chesapeake Bay and the Atlantic Ocean. Training may be coordinated with rehearsals of the Navy recovery crews.

An actual capsule will be gimbal-mounted in the altitude wind tunnel at Lewis Research Center for firing of retrorockets and checkout of the reaction control system. There, the pilots will become familiar with the sound of the retrorockets firing and will become accustomed to using the hydrogen peroxide jet control system.

Familiarization with the weightless condition of orbital flight will be continued with zero gravity aircraft flights. Some of the pilots made such flights early in the program in a specially equipped Convair C-131, and more of these flights are planned. Space Task Group wants to determine the possible effects of acceleration following a zero gravity condition. Some effects were noted in work done at Wright Air Development Center, but they were not considered severe.

Zero gravity flights of longer duration than is provided by the C-131 may be arranged, and STG is studying the use of the Lockheed F-104B for this purpose. Pilots also may fly the Bell X-1B or X-1E during the training program, but no final decision has been made. They will not fly the North American X-15.

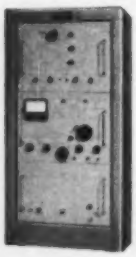
Mercury pilots may use a water tank zero gravity simulator developed here at Langley, although this will be questionable until the tank system has been tested. With this simulator, a man is put in water where he cannot see and is disoriented. This furnishes a fair simulation of zero gravity.

Ball disk space flight control simulator developed here will provide practice in using control systems with no damping and no spring response. The pilot grasps a handle with a disk sus-

numbers you can count on up here...

because they're proved right down here!

Hoffman test equipment checks TACAN accuracy—on the bench or in the cockpit*



HLI-103 BEACON SIMULATOR duplicates all functions of the AN/URN-3 surface beacon. Tests ARN-21 for full azimuth and entire range, closure and departure speeds, surface beacon identity tone and decoding functions. For bench test or cockpit check. Available on 60-day delivery.

HLI-119 TACAN TEST INSTRUMENT. Portable unit tests *accuracy* of ARN-21 airborne TACAN in the cockpit of aircraft on the ramp or carrier deck. Checks accuracy of range and bearing at pre-set points and identification signals. Availability on request.

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pended under it. A ball rolls freely on the disk, and the pilot maneuvers the disk to keep the ball centered on it. The movements and responses required to keep the ball in the center of the disk are the same as those the pilot will use to keep the earth image centered in his periscope. Ball can be blown across the disk with an air jet.

Space Ship Simulator Will Recycle Water

Drinking water will be recycled in Minneapolis-Honeywell Regulator Co.'s space cabin simulator.

The simulator (AW June 22, p. 235), is 90% completed and is expected to be delivered to the USAF School of Aviation Medicine, Brooks AFB, Tex., by the end of September. It is being constructed by the company's Aeronautical Division plant in Minneapolis, Minn.

Urine and all other waste water will be purified by a Honeywell process that includes chemical treatment, filtering, super-heating, freezing and final filtering through activated carbon.

Feces and other solid wastes such as food particles and hair will be dehydrated and burned in an incinerator. Gases produced by this process will be disposed of with an afterburner so the final residue will be a small amount of fine ash.

The seven ton simulator is 8 ft. high and 12 ft. long.

Wind Tunnel Burner Will Heat to 3,500F

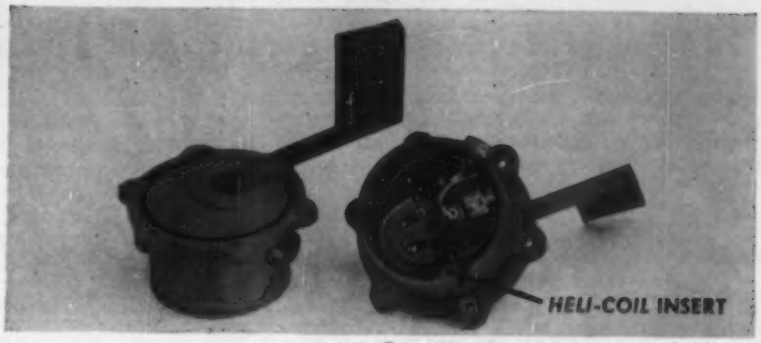
Montebello, Calif.—Hirt Combustion Engineers, Montebello, Calif., will build a 10 million Btu./hr. pebble heater burner to help simulate heating effects encountered by high speed aircraft and missiles during flight in Douglas Aircraft Co.'s Mach 10 hypersonic wind tunnel (AW June 22, p. 249).

Heating range of the Hirt burner will be from 300F to 3,500F.

Subcontract for the burner was awarded by Southwest Welding and Manufacturing Division of Yuba Consolidated Manufacturing Co., which is constructing the pebble heater.

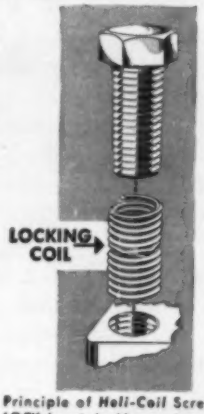
Burner will be designed to withstand back pressure of 2,500 psia. during backflow operations and will be the largest pebble heater burner ever built by Hirt.

Due to the harmful effects of combustion products, wind tunnel heating cannot be achieved directly. The unit in Douglas' Aerophysics Laboratory tunnel will use alumina pebbles heated by the Hirt burner. After the pebbles become hot the burner is turned off and the hot pebbles heat the air.



Heli-Coil® Screw-Lock Inserts lock screws against impact and vibration and permanently protect critical tapped holes in this transducer assembly.*

Critical Electronic Controls Get internal-Locking, Protective Threads with HELI-COIL Screw-Lock Inserts



Principle of Heli-Coil Screw-LOCK Insert. Locking center coil grips internally, holds screw firmly.

Electronic control devices for aircraft and missiles, like this angle of attack vane transducer made by U. S. SCIENCE CORPORATION, LOS ANGELES, CALIF., have to withstand severe vibration, impact, corrosion and temperature change. They must be made of light materials and still have strong threads — able to hold fasteners tightly and stand frequent assembly and disassembly.

U. S. SCIENCE insures rock-solid screw assemblies by protecting vital tapped holes with one-piece *internal-locking* ***Heli-Coil*** Screw-LOCK Inserts. These precision formed, stainless steel wire inserts eliminate thread wear, lock screws securely — without resort to clumsy, external lock nuts and lock wiring.

Simple Installation Procedure

U. S. SCIENCE finds it easy to install ***Heli-Coil*** Screw-LOCK Inserts. Drilled holes are tapped with a ***Heli-Coil*** tap and the Inserts wound in with a prewinder inserting tool. Conventional screws are used in assembling the unit.

Heli-Coil Screw-LOCK Inserts

- positively lock fasteners against loosening under impact and vibration
- prevent thread wear, stripping, corrosion, galling and seizing
- eliminate lock nuts, lock wiring, other supplementary locking devices
- permit repeated disassembly and reassembly
- can be used in standard proportion bosses without need for redesign
- save assembly time, space, weight and cost
- meet government specs for locking torque and vibration

*Patented

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HELI-COIL CORPORATION, 208 Shelter Rock Lane, Danbury, Connecticut
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THE NAVY'S POLARIS:

DONNER *helps it think...*

One day soon the U. S. Navy will file a report more fantastic than any sea serpent tale we've ever heard. This will be the launching of the Navy's spectacular Polaris missile from a submerged nuclear submarine. Advanced testing is underway; the Polaris will be ready for the fleet in 1960.

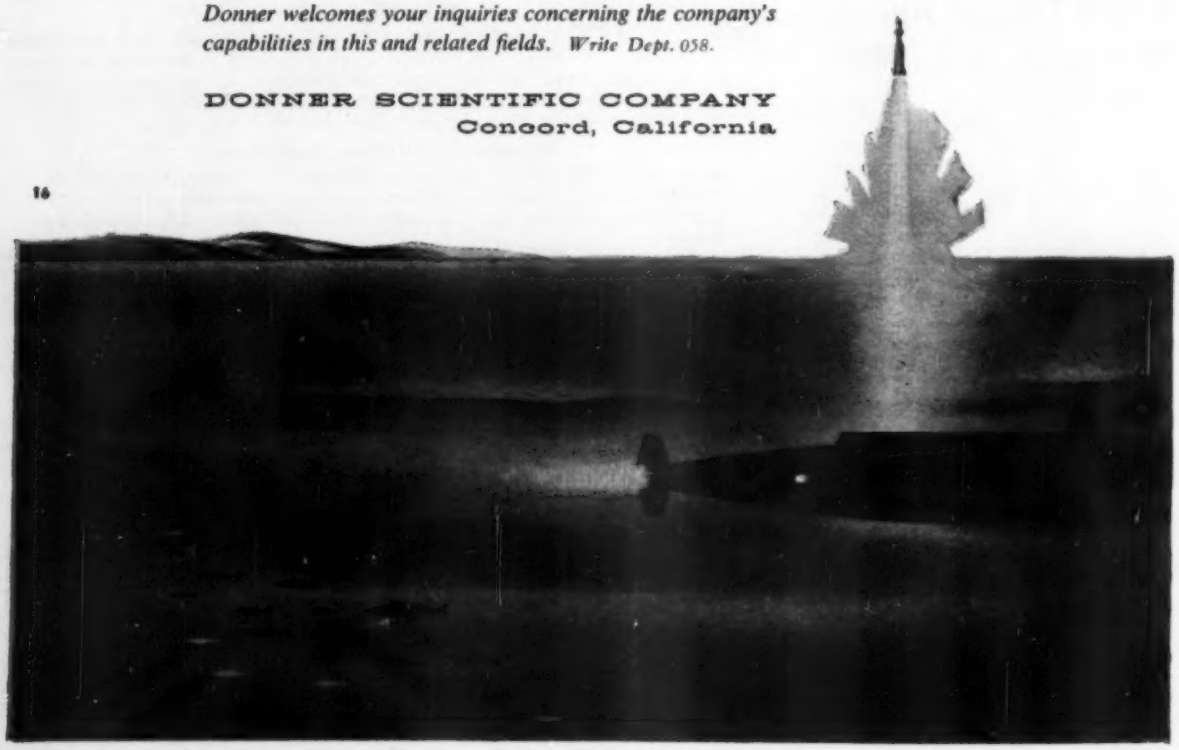
Smaller and lighter than other intermediate range ballistic missiles, this formidable Lockheed developed weapon features much that is new in advanced electronics. It even "thinks" for itself.

One such "think" device aboard the Polaris is a system developed by Donner Scientific Company using as a base a standard Model 4310 Accelerometer. The system monitors flight performance like a policeman directing traffic. If, for example, in the initial portion of the flight, the missile does not achieve sufficient velocity by a pre-determined time, the Donner system aborts the flight. The missile gets the go-ahead only as programmed.

Donner's role in the Polaris project represents another basic contribution from an engineering team which specializes in accurate systems, interlocking time, acceleration, velocity and other inputs designed to meet customers' requirements.

Donner welcomes your inquiries concerning the company's capabilities in this and related fields. *Write Dept. 058.*

DONNER SCIENTIFIC COMPANY
Concord, California



Satellite Radar Must Be Ultra-Reliable

By Philip J. Klass

Washington—Development of a lightweight ultra-reliable weather radar requested by National Aeronautics and Space Administration for use in a meteorological satellite represents a major challenge to the ingenuity of the nation's radar designers.

With a radar-equipped meteorological satellite, NASA scientists hope to obtain a three-dimensional picture of precipitation around the earth, enabling meteorologists to detect major storms early in their development and to measure the earth's heat balance.

Design Requirements

Here are a few of the challenging requirements outlined in the specification which NASA sent to industry:

• **Reliability:** Radar must be able to operate continuously and reliably for a minimum of six months, preferably for a full year. Some simple adjustments for improving performance may be possible by means of remote radio control.

• **Coverage:** Meteorological satellite will be stabilized so that one axis remains perpendicular to the earth's surface, with no rotation about this axis. NASA would like a scanning radar which can provide full coverage of all of the earth that can be viewed from the satellite but will settle for a strip a few hundred miles wide beneath the satellite if the former is not feasible.

• **Range:** First models of the radar will operate from a satellite at an altitude of about 300 mi., but the ultimate design must be suitable for orbits at altitudes of 500 to 1,000 mi.

• **Resolution:** NASA seeks a resolution equivalent to about 5 mi. on the earth's surface. This corresponds to a beamwidth of about one degree for a satellite at 300 mi. altitude. To establish height of precipitation above the earth, NASA seeks a range resolution of about 1,000 ft.

• **Electric power:** First models will be powered by solar cells and storage batteries capable of supplying only 50 to 100 w. average power, NASA says. Ultimately, the power available in the meteorological satellite is expected to be one to five kilowatts. (By way of comparison, existing airline weather radars with a maximum range of about 150 mi. require 750 to 1,000 w. power).

• **Sensitivity:** If possible, radar should be capable of detecting precipitation falling at the rate of 0.1 in. per hour, corresponding to a radar reflectivity of 0.0000005 sq. meters per cubic meter. Radar receiver should have a logarithmic response as a function of received signal strength. Receiver output should be in discrete steps with 5 to 10 levels.

• **Antenna.** Because physical movement of the radar antenna to achieve scanning would produce torques that would disturb satellite stabilization, NASA suggests the use of slot type antennas and electronic scanning techniques.

Requesting Proposals

NASA is asking industry for proposals on both a feasibility study of the satellite weather radar and on a second phase that would include fabrication of a working laboratory model. Feasibility study is to be completed by July, 1960, and should indicate how an early model can be developed into a more sophisticated ultimate system for use in an operational satellite. NASA is asking that the laboratory model be available by spring of 1961.

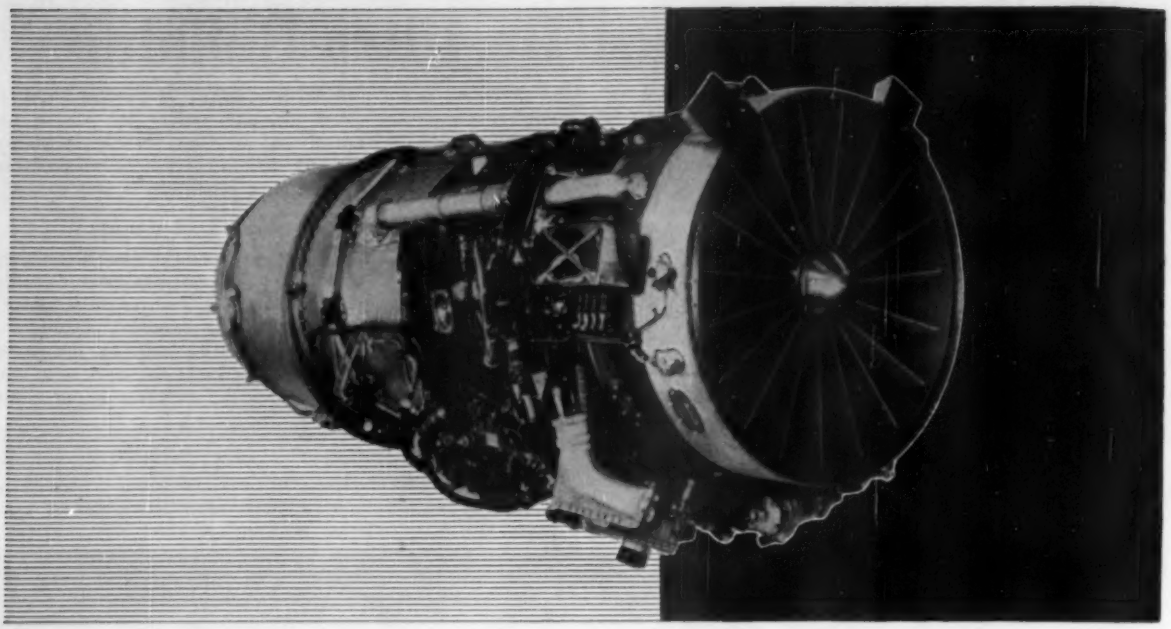
Unclassified Techniques

Insofar as possible, the techniques employed in the satellite radar are to be unclassified, NASA says. If it proves necessary to use classified techniques, NASA says it will arrange for the use of such information by the contractor and will respect the classification of these parts of the work.

NASA suggests the use of X-band (3.2 cm.) for the satellite radar in preference to lower frequencies because of the problems of obtaining desired reso-

Scientists Study Entry into Venus' Atmosphere

Blunt nose shape is placed at end of 40-ft. shock tube in Lockheed Missiles and Space Division's Scientific Research Laboratory in a study of the problem of entry into the atmosphere of Venus. Studies by scientists K. K. Chan (left) and Richard W. Rutowski (right) show problem is 50% greater for Venus than it would be for a return to earth.



DEVELOPED FROM EXPERIENCE

The Rolls-Royce Conway by-pass turbo jet is in production for the Handley Page Victor B.Mk.2, the Boeing 707-420 and the Douglas DC-8, and will power the Vickers VC.10.

The by-pass or ducted fan principle which Rolls-Royce have proved in the Conway is now accepted as the correct formula for all jet transport and for certain military applications. The new RB.141 family of by-pass jet engines is based on 7 years' development experience of the by-pass principle and on 6 years operation of other gas turbines in airline service. The first of this series of engines has already been chosen to power the new British European Airways medium range jet airliner.

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lution with reasonable size antennas. However, it does not rule out the use of other frequencies.

In the ultimate operational meteorological satellite, a tremendous amount of radar data will be collected. Present plans are to store the data aboard the satellite on a tape recorder, then transmit it down when the satellite passes over a ground radio station.

The contractor selected to study and develop the satellite radar need not concern himself with the the design of the data storage, communications and primary power source except as the latter affects the radar design, according to NASA.

Companies that would like to bid on the satellite weather radar program may obtain copies of the specifications and other details by contacting: Director of Procurement and Supply Division, NASA, 1520 H St. N. W., Washington, D. C.

Soviets Measure Geomagnetic Field

Moscow—Soviet Union has disclosed some of the results of its satellite and rocket program to scientists at the International Cosmic Ray Conference here. A report on the results of Soviet space research that was delivered last March to the USSR Academy of Sciences by its president Alexander Nesmeyanov has been published in summary in recent Soviet newspapers.

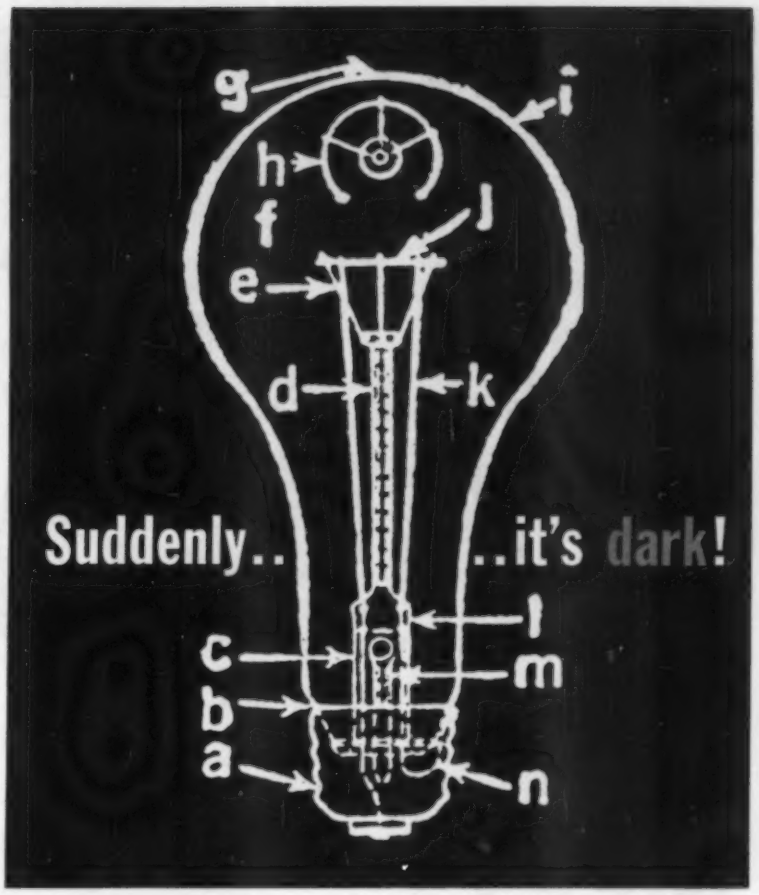
The report states that Soviet research has established that ions with a mass number of 16 predominate at heights from 226 to 1,000 km., with atomic oxygen constituting the basic gaseous component from a height of 226 km. to at least 800 km. Atomic nitrogen ions also have been detected as well as heavy particles with molecular weights of 28 and 30, Nesmeyanov said.

"With further investigation [this detection] can be instrumental in solving the ionization balance problem of the upper atmosphere," he said. The report noted that atomic nitrogen content in relation to atomic oxygen ranges from 1% to 10% depending on height and geographic latitude and varies with lapse of time. "Definite dependence of all discovered components of the ionosphere on geographic latitude has been determined," the report continued.

Nesmeyanov said "extremely important results were obtained in measurement of the geomagnetic field with the help of Soviet space rockets."

"It has been established" he said, "that the difference between theoretical and factual values becomes noticeable at a distance of approximately two terrestrial radii from the center of the earth and then increases sharply."

Variations in the magnetic field



A pretty dark situation, indeed—when a *single* electron tube failure can shut down an equipment or entire production line test facility! Use IERC's new set of a, b, c's to help you get improved electronic equipment reliability. **a.** The practice of replacing tube failures in manner and attitude like that of replacing a light bulb is neither protection nor cure against a continuing high rate of electron tube failures! **b.** Downtime, labor replacement costs often add up to 10 times the tube cost! **c.** You can actually increase tube life up to 12 times by specifying and using IERC Heat-dissipating Electron Tube Shields! The full facts, in the form of **d.** complete product literature, **e.** test reports, **f.** engineering data and **g.** tube shield application guides, especially prepared to help you "see the light," are available on request—write today!

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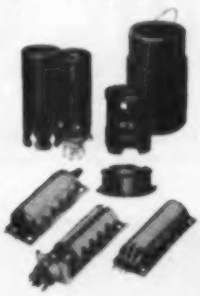

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of the earth can only be explained by supposition that at a height of 21,000 km. the rocket crossed a current-conducting layer, according to the report. Thus, information sent by the rocket indicates the existence of a current-conducting system outside the ionosphere. It was stressed that this fact is of fundamental importance for the theory of magnetic storms and aurorae and specifically for critical reappraisal of current explanations of these phenomena.

Rehashing previously published information, Nesmeyanov said Sputnik III and space rocket observations showed that danger of meteors and micrometeors is negligible in outer space. He said a particle with a mass about one thousand millionth of a gram is likely to be encountered by a space rocket only once in several hours.

In reviewing what had been published on radiation, Nesmeyanov said the outer zone has been "spatialized" with accuracy and further data has been obtained on the composition of charged particles in that zone by analysis of readings of space rocket instruments.

Electron energy within the maximum radiation band is about 25 and on the zone boundary about 50 kev.

The scientist's only published allusion to Project Argus (AW Mar. 30, p. 26) was a statement that "fallout from high altitude atomic explosions can produce intense streams of charged particles at those altitudes." He said these particles will be locked in a magnetic trap since they have low energy.

Soviet scientists consider that atomic explosions can thus have the effect of "polluting" near earth's reaches of space. He also claimed that Soviet research has shown basic physiological functions of test animals do not alter appreciably in conditions close to that of space flight, noting that "one of the highly important findings of the second Soviet Sputnik was the fact that the state of zero gravity does not appear to have any unfavorable effect on vegetative functions of organism."

"It is advisable to create spatially oriented artificial satellites for a number of lines of solar research," he added. "It is desirable for satellites be oriented on the sun.

"In an another instance satellites will have to be oriented so as to have one of their axes directed towards earth and other coinciding with their orbital path. Astrophysical research requires satellites to remain static in relation to fixed stars," Nesmeyanov said.

A manned trip to the moon with a landing and return to earth can be expected to take place in what may well be in the not so distant future," he said. Exploration of Venus and Mars was of "particular interest," he concluded.

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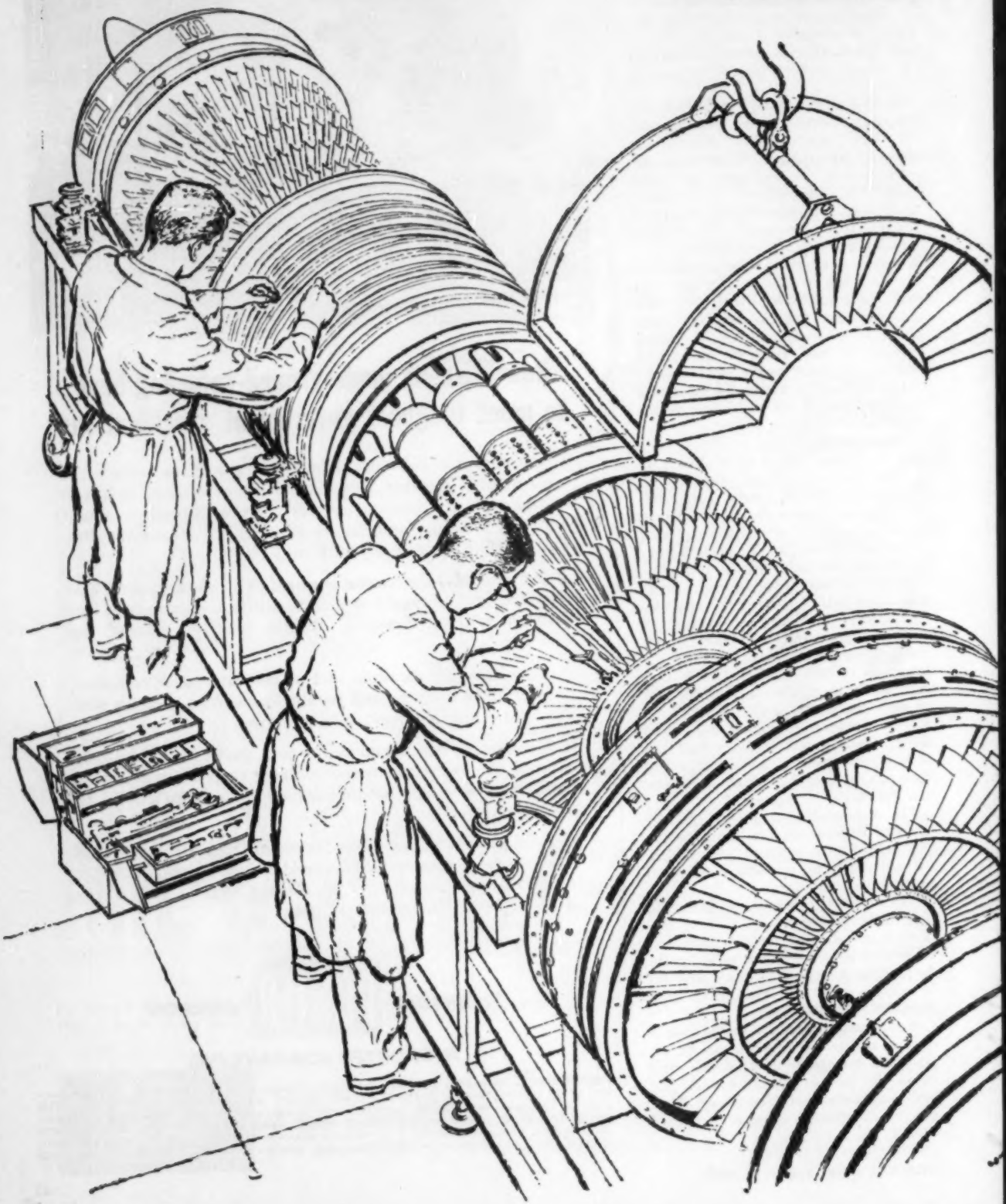

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Because the fan package goes aft, General Electric turbofans further the long-standing tradition of exceptional maintainability *designed into* every G-E engine.

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- Split gas generator casings provide ease of maintenance and inspection and facilitate sectional overhaul.
- Combustion liners, fuel nozzles, igniters, turbine buckets, and compressor stator blades are *individually replaceable in the engine.*
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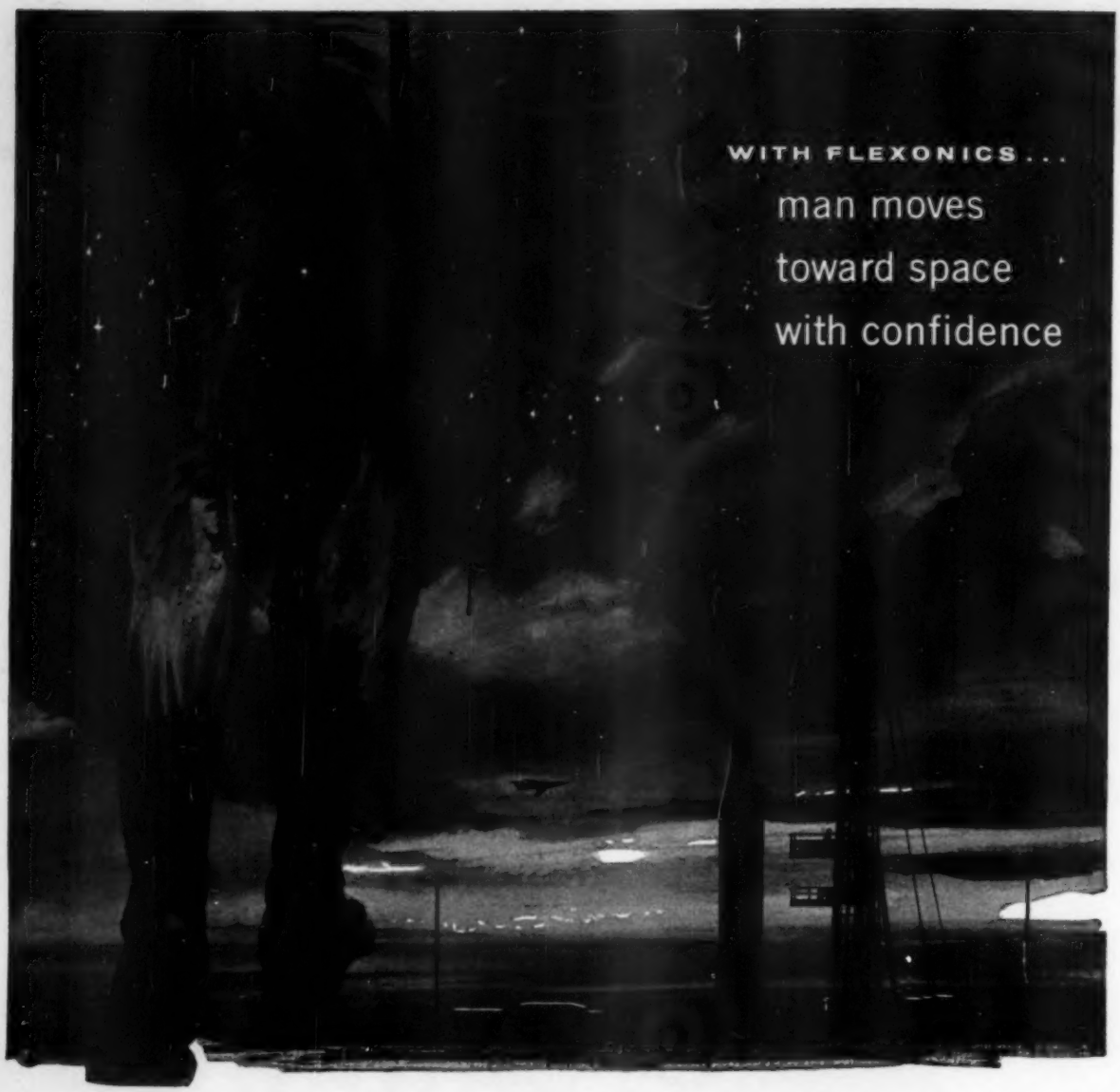

When man first steps into the vehicle that will carry him into outer space, it will be with complete confidence.

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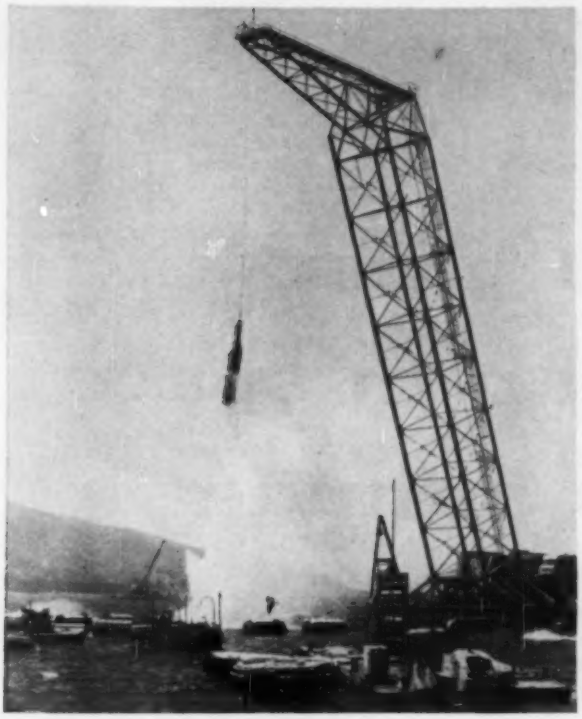
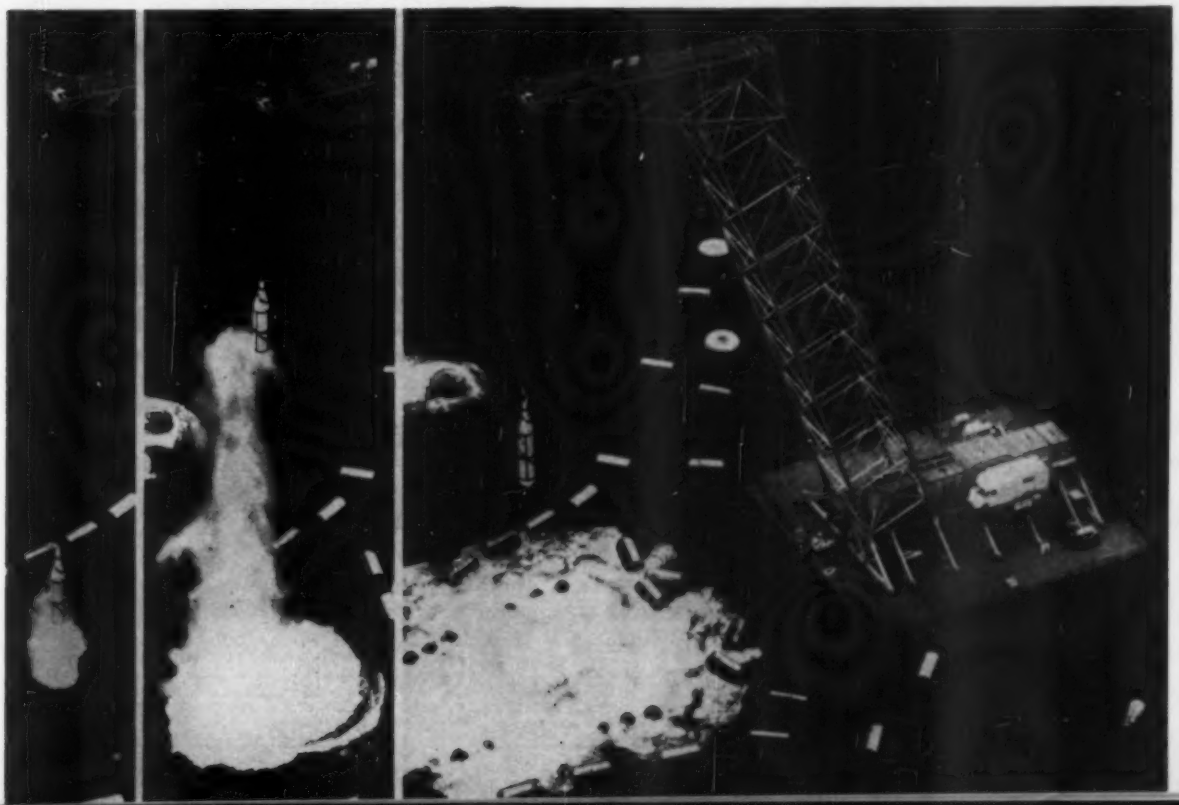


Crane, Hydraulic Ram Retrieves Polaris Dummy In San Clemente Tests

Lockheed Missile and Space Division and Westinghouse Electric have developed Operation Fishook to retrieve dummy Polaris missile shapes after firing from an underwater launching tube. Missile is reeled in by cable operated from the 186 ft. high crane; hydraulic ram-type piston braking is used to keep the Polaris from falling back into the sea. Fishook is in operation at San Clemente Island sea range of U. S. Naval Ordnance Test Station, China Lake, Calif. Earlier recovery method involved use of modified carrier aircraft arresting gear (AW May 25, p. 69).



Honeywell puts man in space –at zero altitude

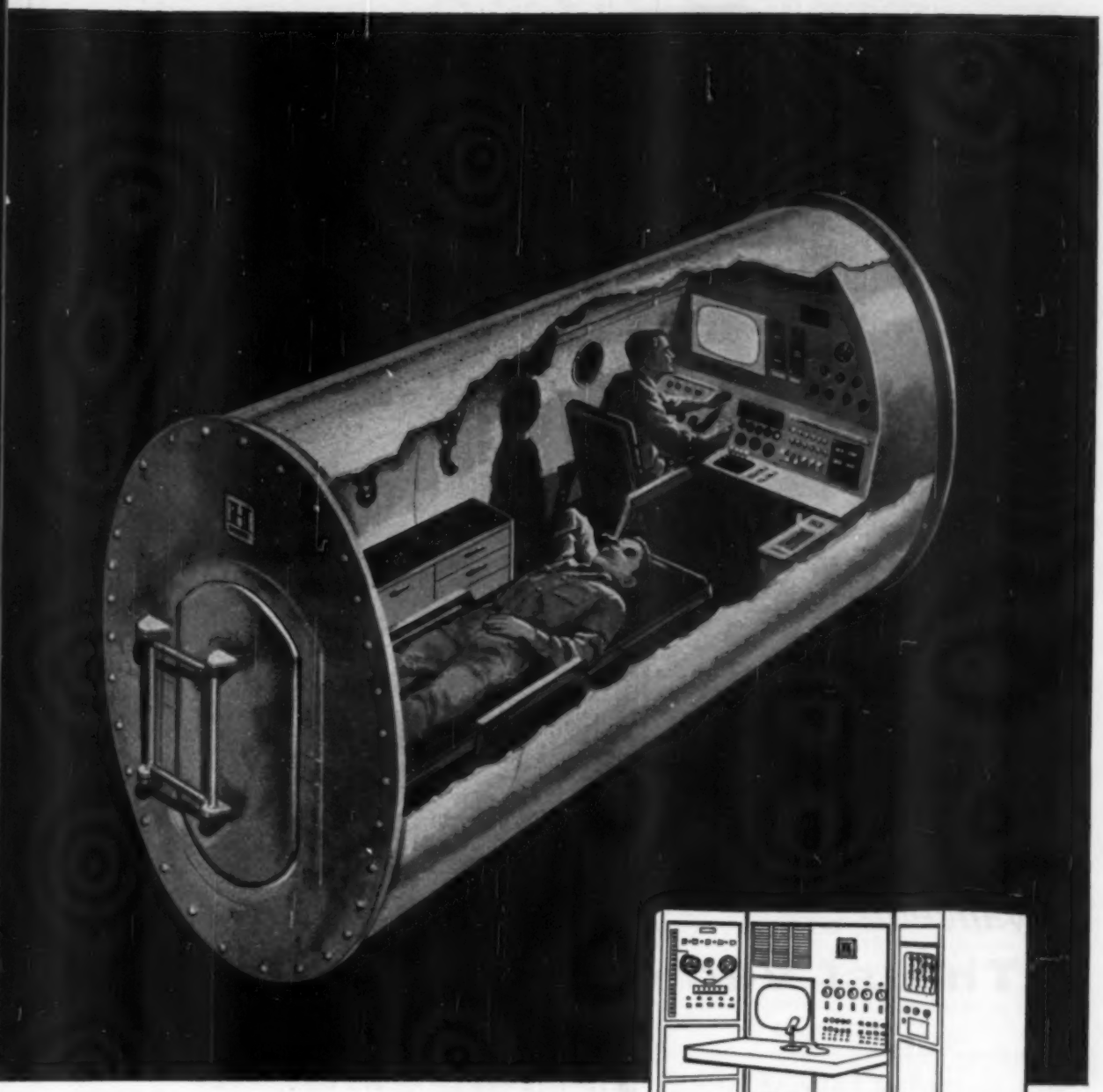
Advanced space environment simulator will isolate two men in Honeywell-controlled space flight environment during unprecedented 30-day test

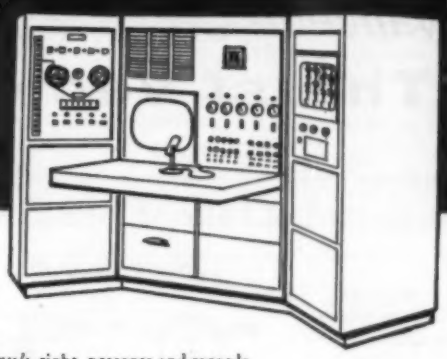
AS ANOTHER step toward man's conquest of space, Honeywell will provide the USAF School of Aviation Medicine with an environment simulator for use in researching human reaction to isolation in space. The test capsule developed by Honeywell will hold two men and all the life-sustaining materials they need for 720 hours. It provides a completely self-sufficient environment contained in a 12- x 6- x 5-foot package. When man travels space, the air he breathes, the food he eats, temperature control, waste disposal, and all other basic elements must be precisely planned and controlled. This poses intricate problems involving toxic gas, filtration, oxygen, lighting, and many others. In solving them Honeywell utilizes advanced engineering techniques developed during more than 70 years of leadership in environmental control.

Honeywell Capability

Human environment, however, is only one of many fields in which Honeywell can demonstrate space-flight capability. For example: *Guidance and Stabilization* Honeywell's reference system is a remarkably accurate means of missile guidance and control proved in actual applications. *Flight Control.* Honeywell has more experience in the field of flight control than any other company. Proved systems include autopilots, reaction controls, jet vane controls, thrust vector controls and automatic landing systems. *Data Processing.* Honeywell capability includes sensing, recording, transmitting and interpreting. *Ground Handling.* Some of the most extensive and complex work done by Honeywell in the missile field concerns the development and operation of test and checkout equipment. This work includes depot overhaul and maintenance equipment, base level overhaul and maintenance equipment, and launch site checkout equipment. Additional Honeywell experience includes instruments, auxiliary airborne power systems and research into human factors, both biochemical and psychological.

If you have a problem in the design of systems or components in the field of space flight, call or write Honeywell, Military Products Group, 2753 Fourth Ave., South, Minneapolis 8, Minnesota.





Two-man hermetically-sealed space cabin simulator. The basic chamber of the simulator will contain equipment that would be found in actual space flight. Oxygen, carbon-dioxide, toxic gases, temperature and humidity are constantly and individually sensed and compared to a set value. When safety limits are exceeded an error signal is amplified and corrective action is automatically begun. A sufficient water supply and facilities to insure personal cleanliness will be provided. Ample storage facilities for nonperishable foodstuffs will be provided for the 30-day isolation.

Exterior console, right, presents and records data concerning conditions inside the capsule. Permanent records will be kept by audio recording, TV kinescopes, and camera equipment.

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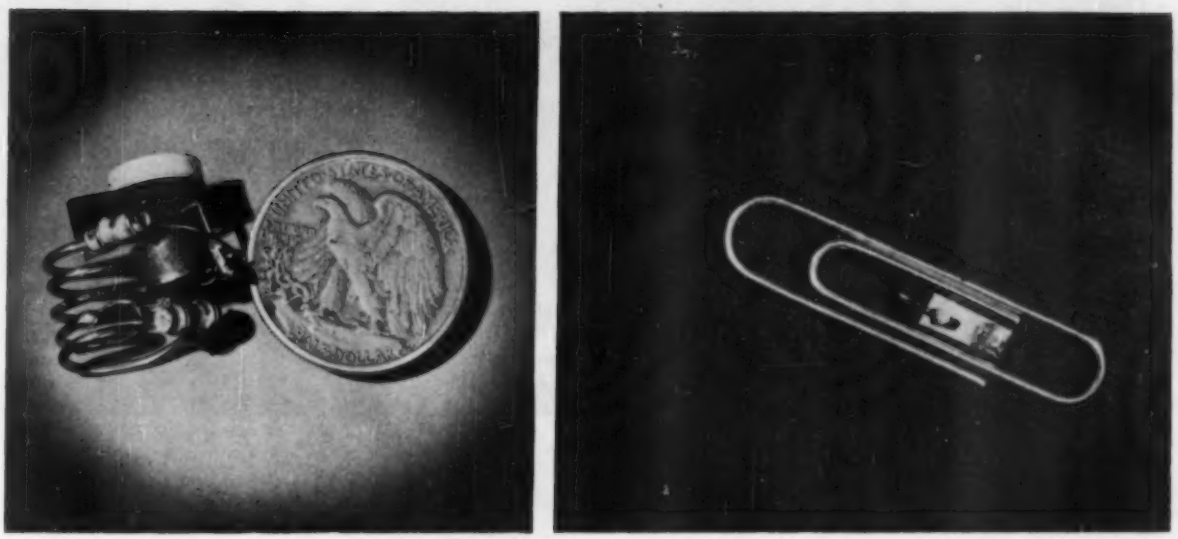


TUNNEL DIODE transmitter (left) consists of one variable and two fixed ceramic capacitors, tuning coil, and the tunnel diode located inside the can. Close-up of a tunnel diode (right) shows the connecting wire leading into an alloy dot which is soldered to a germanium crystal (dark area) which in turn is soldered to a rectangular metal plate that forms the other connection.

Tunnel Diodes May Cut Transistor Costs

By James A. Fusca

New York—Semiconductor researchers are becoming increasingly interested in the promising new device called the "tunnel diode." Latest results to be announced are those of scientists at the General Electric Research Laboratory where tunnel diodes have been incorporated in operating experimental circuits such as an FM transmitter, an FM receiver, and in microwave and crystal-controlled oscillators.

Sample Quantities

Characteristics of the tunnel diode that have attracted interest include the ability to operate at frequencies as high as 10 kilomegacycles, power requirements as low as one millionth of a watt, and an amplification noise figure of about one decibel.

General Electric says that it will be offering tunnel diodes in sample quantities by late September at an approximate price of $75 per diode. Eventually the company hopes to make available a complete line of different types of tunnel diodes at prices below the cost of the various types of transistors available commercially today.

Tunnel Diode

The tunnel diode takes its name from the quantum-mechanical tunneling phenomenon by which electrical charges move through the device at the speed of light. This high speed makes possible operation at extremely high frequencies. Oscillators employing tunnel diodes have been operated successfully at frequencies above 2,000 mc., and General Electric says that it expects to obtain operating frequencies above 10,000 mc. in the near future.

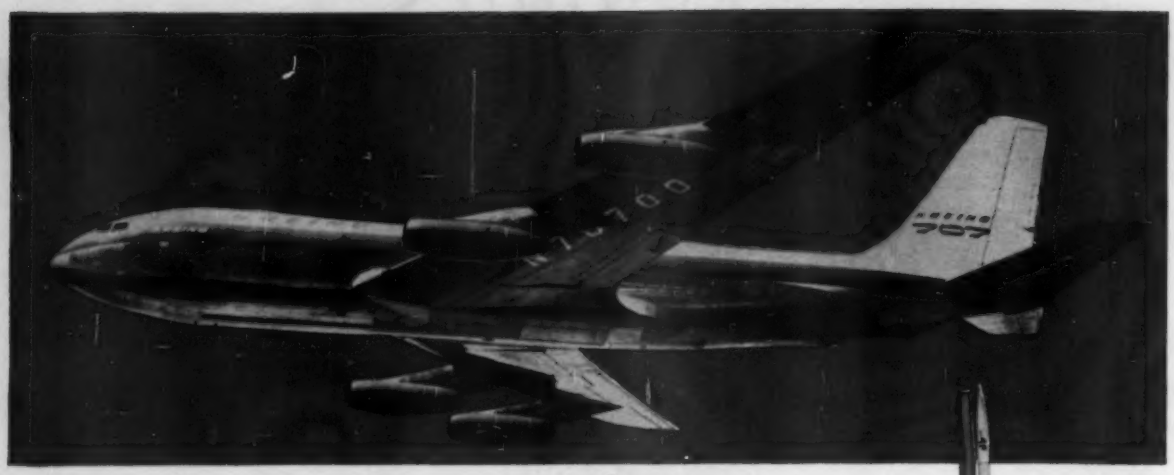
Several advantages are claimed for the tunnel diode in comparison with transistors. The tunnel diode is smaller than a conventional transistor and, because of its simpler structure, ultimately should be reduced to a fraction of its present size. It is relatively immune to environmental conditions. Silicon tunnel diodes made by General Electric have been operated at temperatures to 650F. Measurements indicate that the device is 1,000 times better at resisting the actual effects of nuclear radiation.

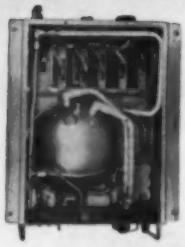
One of the most interesting characteristics of the tunnel diode is that it is a negative resistance device. First reported by Dr. Leo Esaki of Japanese Sony Corp. in early 1958, the device has attracted wide attention in this country. Other research facilities known to be actively investigating tunnel diodes are RCA Laboratories, Bell Telephone Laboratories, and Air Force Cambridge Research Center. Several different materials are being studied, including silicon, germanium, gallium arsenide, gallium antimonide, indium antimonide, and silicon carbide.

In quantum-mechanical tunneling, an electron, or a hole, disappears from one

Comparison of Tunnel Diode Characteristics

	Maximum Frequency Of Operation (in kmc.)	Minimum Power Requirements (watts)	Low Noise Amplification (Noise Temperature at 1,000 mc.)
Tunnel Diode	2–10	0.000001	100–300K
Transistor	2	0.001	3,000K
Vacuum Triode	10	0.1	900K
Parametric Amplifier	6	10	35K (at room temp.)
Traveling Wave Tube	60	10	300K
Maser	10	400	20K





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. . . concept to reality in one year

Just one year ago, the Air Force Global Weather Reconnaissance Program was only a system concept. Today, the feasibility of this advanced airborne system has been demonstrated at realistic speeds and altitudes.

The Bendix AN/AMQ-15 system includes advanced aircraft sensors for measuring thirteen geophysical parameters along the flight path, and advanced dropsonde and rocketsonde sensors for measuring eight parameters in a vertical profile from sea level to 150,000 feet. Other subsystems are storm radar, cloud top and base radar, air sampling, airborne digital data processing and display, and ground data handling.

For flight demonstrations up to altitudes of 45,000 feet, the Boeing Airplane Company has installed AN/AMQ-15 subsystems in their prototype 707 jet transport. In addition, Bendix has conducted firings of rocket test vehicles at Holloman Air Force Base.

In reporting this achievement of a major system design and implementation, Bendix is very proud of the contributions of its own divisions, and is most appreciative of the cooperative teamwork provided by the Air Force, Boeing, and other subcontractors. The result is a flexible and modular system which can be used in various sized packages for all types of aircraft ranging from strategic bombers to interceptors, and for civilian transport aircraft.

The AN/AMQ-15 is typical of the hard-hitting programs being carried out by Bendix Systems. Better engineers and scientists interested in pioneering systems of the future are invited to join this growing team.

Bendix Systems Division
ANN ARBOR, MICHIGAN

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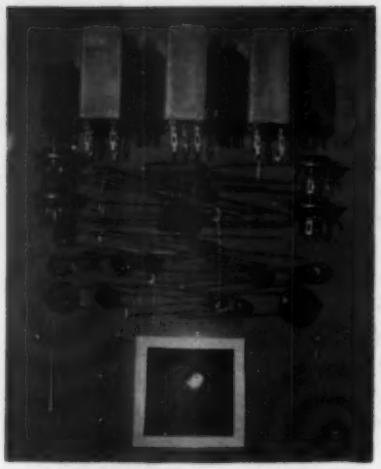


TUNNEL DIODE, shown in can at bottom, is capable of the functions necessary for an FM receiver: amplification, oscillation, conversion, limiting, detection, and automatic frequency control. An FM receiver built using a tunnel diode, the conventional components shown at the top could be omitted, with some sacrifices in performance.

side of a potential barrier and instantaneously reappears on the other side, although it does not have enough energy to surmount the barrier. In the case of the tunnel diode, the barrier is the space charge depletion region of a p-n junction. This is the same barrier which prevents current from flowing in the reverse direction in an ordinary rectifier diode.

This barrier is made extremely thin in the tunnel diode—less than one millionth of an inch—so that penetration by the tunnel effect is possible.

This gives rise to an additional current in the diode at very small forward bias which disappears when the bias is increased.

It is this additional current that produces the negative resistance in the device.

Free Carriers

The origin of this additional current can be understood by considering the changes in the characteristics of a conventional p-n junction diode as higher concentrations of free carriers are added in a semiconductor crystal.

As the density of charge carriers is increased, the reverse breakdown voltage decreases.

This reverse breakdown voltage, however, does not reach a limit at zero. The lower limit is determined by the solubility of the impurities which determine the carrier concentrations. Experiments have shown that many semiconductor materials can be doped heavily enough so that the diode can still be in the reverse breakdown condition at a small forward bias.

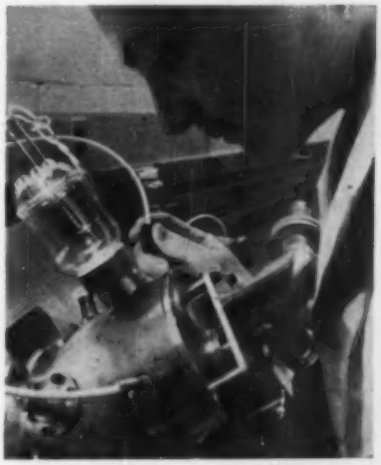
When a larger forward bias is applied, the diode goes out of the reverse breakdown condition and the current falls to a small level. The reverse breakdown current that flows with a forward applied bias establishes the negative resistance of the device.

Diode Advantages

In competition with conventional tubes, transistors, and other electronic devices, General Electric believes tunnel diodes have the following advantages.

• **For communications applications,** tunnel diodes compete with transistors, parametric amplifiers, vacuum triodes, magnetrons and klystrons, traveling wave tubes, and masers. Tunnel diode characteristics to be compared are their high oscillation frequency, microwatt power requirements, and very low noise amplification (noise figure of about one decibel).

• **In computer applications,** tunnel diodes will compete with transistors. The diode is at least 100 times faster than present day transistors, according to General Electric, and can be made to consume only about 100th of the power. Tunnel diodes also are relatively insensitive to temperature changes, which may permit circuit simplification without sacrificing reliability.



Electrostatic Gyro

Highly accurate electrostatic gyro whose spinning rotor is suspended in a vacuum by electric fields instead of by conventional bearings is shown here. Extremely low-drift gyro, developed by Minneapolis-Honeywell, uses spherical rotor made of beryllium and machined to tolerances of 15/millionth inch. Honeywell began this research under Navy Bureau of Ordnance sponsorship, and recently received USAF contract to study airborne application. Glass tube atop gyro case is a gage to measure internal vacuum. General Electric also is developing electrostatic gyro suspension.

ONE SURE SOURCE

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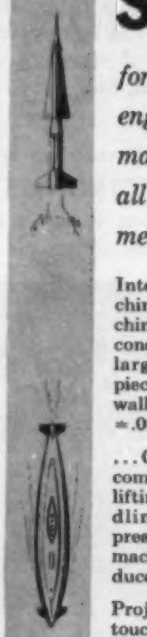

Interested in precision machined parts? . . . Bliss machines rocket and missile nose cones, domes and cylinders, large diameter thin-walled pieces that must be held to wall thickness tolerances of ±.002".

. . . Or atomic assemblies and components? . . . Reactor core lifting and other core handling equipment, welded pressure vessels and small machined parts are all produced by Bliss.

Projects with more than a touch of the unusual? . . . Most U. S. Navy carriers have Bliss-built catapults . . . Just recently a Bliss overrun barrier saved both pilot and plane when a jet's brakes failed . . . Right now you'll find sections of what will be the world's most powerful radio telescope being assembled on the 600,000-square-foot floor of the Canton plant, one of ten Bliss plants in the U. S. In a word, Bliss has the facilities and skills to take any job involving metal manufacturing from plan to finished product.

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Leading companies in missiles, aircraft and electronics look first to MB for progress in complete vibration test systems. It has been that way for almost 15 years. Our "encyclopedia" of vibration experience is yours to draw on... as is the largest, national, field service staff of specialists. Send for full data.

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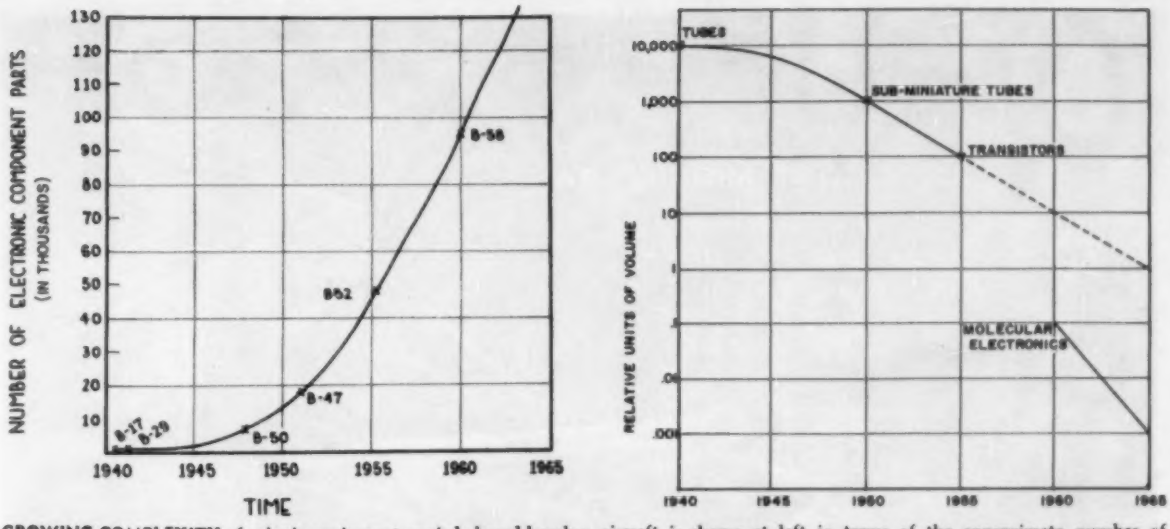

GROWING COMPLEXITY of avionic equipment carried aboard bomber aircraft is shown at left in terms of the approximate number of components, each a potential source of equipment failure. Miniaturization gains achieved in the last two decades through the use of smaller components, tubes and transistors, are compared at right with the results expected from the Air Force's new molectronics program.

USAF Investigates Basic Molectronics

Dayton—During the past decade, Air Force weapon systems have become increasingly complex in order to accomplish their increasingly difficult mission assignments. One vivid example is in the number of electronic components required. Whereas the Boeing B-17 and B-29 avionic equipment used only a couple thousand components, the B-47 has an estimated 20,000 and the B-52 approximately 50,000. The total for the Convair B-58 is around 95,000 and the North American B-70 will show a corresponding increase.

Design Problems Created

This trend has created a number of major problems for the air/space vehicle designer, including size, weight and electric power requirements. Perhaps the most critical is the lesser reliability which results from the irrevocable law of nature that the reliability of a system is equal to the product of the reliabilities of each of its individual components. In addition to the components themselves, there usually are two soldered connections for every component—each another potential source of failure.

The electronics industry has not been standing still during the last few years. It has improved the performance of components and has made significant reductions in their size. However, the curve reveals that the reduction in size has been approximately a straight-line function for the past several years. This is not adequate to meet the greatly increased complexity of weapon systems and the demands for small size, weight and power of air and space vehicles.

Furthermore, it appears that a continuation of this evolutionary change cannot meet our needs. We need a new concept, or breakthrough, in the electronic components field.

Several years ago this situation was discussed with a number of representatives from industry and contracts were placed with hopes that breakthroughs would be achieved.

From a contractual standpoint, these programs were relatively successful, but we learned that one cannot contract for a breakthrough.

At that time we were thinking of functional components which were defined as single items that could replace a tube or transistor and its family of supporting passive components. These functional components were to amplify, switch, oscillate or perform one of the many other functions normally found in avionic equipment. We were even so visionary as to think of a complete communications or radar receiver that would be so simple as to have input, output and power leads only, with the innards being a solid material instead of an assembly of hundreds of components.

The term "molecular electronics" has been used by the Air Force to describe this technology for which we were searching. Molecular electronics has been defined as the synthesis of matter with predetermined electronic properties so that under a particular stimuli, the matter exhibits complex and complete electronic functions that previously were performed by distinctive combination of active and passive components.

A molecular electronic item that performs such a function has been named a "functional electronic block," or FEB (pronounced "Feeb") for short. A FEB might, for example, be a band-pass amplifier having a gain of 40 db. at 455 kc. with a 10 kc. bandwidth and an output of 100 microwatts.

Research Program

Because the previous contractual effort was not completely successful, it was felt that the next best thing would be to create a research program whose output would be an environment conducive to revolutionary advancements or even breakthroughs.

To accelerate a scientific revolution in this field through application of molecular electronics required new knowledge and tools which could only be obtained through intensive and exhaustive research programs. The success of the molecular electronics approach is highly dependent upon the revelation of basic information locked in the confines of atoms, molecules and crystals of matter, and on the development and application of new and novel concepts and approaches to the design of useful systems.

Full advantage had to be taken of

Current Air Force philosophy and research effort in molecular electronics (molectronics) is described in this article prepared for Aviation Week by H. V. Noble and Robert D. Larson. Mr. Noble is technical director of the Wright Air Development Center Electronic Technology Laboratory. Mr. Larson is chief of the laboratory's Advanced Solid State Section.

6448-AC

POGO-HI
(II E3c)

P-107
AIR LAUNCHED

P-106
GROUND LAUNCHED

AERONCA TARGET MISSILES PERFORM A VARIETY OF MISSION PROFILES... WITH SUBSTANTIAL ECONOMY

The adage "practice makes perfect" keynotes today's concept of missile warfare. Against supersonic targets, there isn't time for "the second barrel". Therefore, extensive operational testing of air defence systems . . . and training programs for personnel who operate them . . . must be conducted to assure national preparedness.

To accomplish this requirement at minimum cost, Aeronca has developed two expendable, lightweight, high-performance target systems under the Design-Tool-Produce envelope concept. These proprietary missile programs, the P-106 and P-107, are designed for supersonic performance and accurate scoring at all required altitudes, speeds and ranges. ***And their production cost is projected to be substantially less than any current target missile system!***

Another Aeronca-produced missile project is *Pogo-Hi II E3c*. Ground launched to high altitudes, this target utilizes a radar reflective parachute and an infrared emitter package. It is used as "bait" for such current projects as *Nike, Talos, Sidewinder* and *Falcon*.

With integrated Design, Tooling and Production capabilities, Aeronca can produce weapon systems envelopes at either prime or subcontractor levels.

AERONCA manufacturing corporation

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Operational expansion has created openings for additional senior engineers. Write to W. W. Gordinier, Personnel Manager.

scientific discoveries that had accrued over a great many decades. This meant that every known physical effect or phenomenon needed to be re-examined and studied in the light of recent developments and improvements in the purity and structural perfection of materials.

There are literally hundreds of such effects, many of which have been known for a century or more. Some, like the Seebeck Effect, have enjoyed limited usage for many years, whereas others like the Peltier Effect have been largely ignored until recently.

Other Phenomena

Although studies on the application of the Peltier Effect and the Hall Effect have recently been reactivated with exceptional vigor, there are many other phenomena that are not being exploited even though they may prove as valuable for electronic applications. Some of these phenomena may find wide application in the conversion of energy from one type to another, from active to passive stages and the reverse, and for changes in the polarization of energy.

It is important that these effects be brought to the attention of the molecular electronic systems engineer together with a mathematical treatment of their primary and secondary effects. The Georgia Institute of Technology is working under Air Force contract to compile a wide variety of such effects and phenomena.

Research must be expanded to increase the chemical purity and improve the structural perfection of existing materials, as well as synthesizing new materials for molecular electronic applications. The properties of these improved materials must be related to the various phenomena in order to tailor-make materials with enhanced figures of merit for those phenomena of interest to the molecular engineer.

Investigations in the field of semiconductor materials and devices have shown the importance of examining the microscopic properties of materials and of the application of quantum mechanical theory to describe fundamental physical phenomena. It appears logical that the same type of study, with equal or greater degree of intensity, should be directed toward research on non semiconductor materials.

Microscopic Properties

A determination should be made for a great variety of materials of the degree of contribution to the microscopic properties of the materials of such imperfections as electrons and holes, phonons, grain boundaries, thermal and displacement spikes, surfaces and dislocations and Frenkel and Schottky defects.

It also is necessary to determine the influence of the presence and spatial distribution of various impurities in

REC's NEW DEICED TEMPERATURE PROBE

This extraordinary new Model 102D gives accurate total temperature measurement *while* deicing heater operates

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The unique ability of this probe to permit precise total temperature measurements *while* deicing heat is continuously applied opens up numerous possibilities. Model 102D will deice within one minute when subjected to icing conditions defined in Section 3.5, paragraph g of MIL-P-25632A (USAF). Model 102D is designed for use at flight speeds up to Mach 3.

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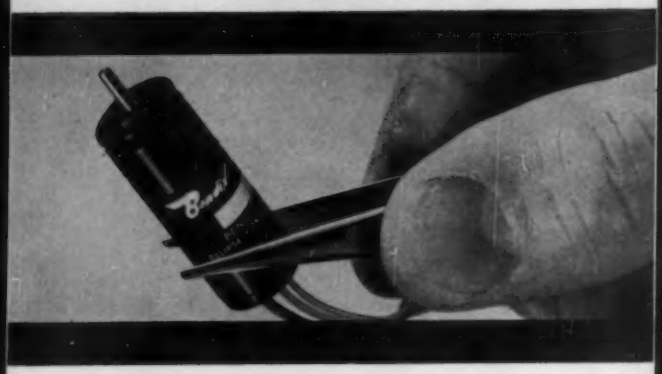

Weighing a mere 0.94 ounces, the new Bendix size 5 servo motor is ideal for meeting the ever-increasing, space-saving demands of miniaturization. And, as with other Bendix servo motors and generators, large-scale precision manufacturing makes possible laboratory quality at volume prices.

The new motors, with their center-tapped control windings, eliminate the need for coupling transformers and thus help solve packaging problems. Besides size 5, you can choose from sizes 8, 10, 11, 15, 20 and 28. Both corrosion-resistant and high-temperature models are available. Other features include: high-operating torque characteristics . . . availability of integral gear heads for frame sizes 8 and 10 in ratios from about 10:1 to 6000:1 . . . and one-source engineering of complete "package".

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amounts as low as one part in one billion, or more if necessary.

Also the influences of temperature, pressure, light, magnetic and electric fields, and the generation or change of various effects with the application of these conditions singularly and in combination.

Research on some selected effects in specific materials is now under way at the University of Pennsylvania, under Air Force sponsorship.

Mathematical Expressions

Another area that requires research is the derivation of mathematical expressions to describe the circuit and system functions which are to be performed in advanced molecular electronic systems.

The Pennsylvania State University is assisting the Air Force in deriving these mathematical expressions.

In many cases, the mathematical expressions for existing circuits and systems are well known and understood. Therefore, much of the effort concerned with conventional electronic operations should be directed toward cataloging and summarizing these mathematical expressions.

For many years mathematicians and engineers have directed considerable attention to the analytical group of operations which includes the study of continuous variation. Topics of interest in this group might include such studies as integration, differentiation, solutions of simultaneous equations, diophantine analysis, and stochastic processes. There is much original work that could be done in the non-analytical type of operations which could prove extremely useful for design of machines employing the theory of automata, combinatorics, sequential systems and probablistic logic.

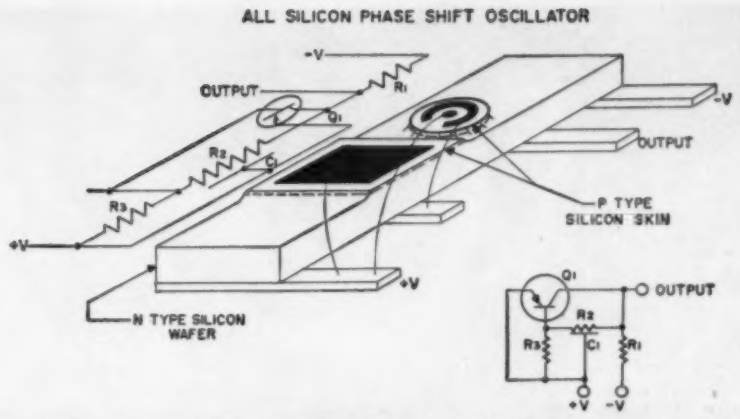
With such a fund of information on the mathematical expressions for various physical phenomena and effects and a compilation of the mathematical expressions required for different electronic functions, the design of functional electronic blocks (FEBs) might be carried out by computers which would combine phenomena as required to produce the desired function.

Practical Application

There still remains a large technological step between the theoretical design of a molecular electronic equipment and the reduction of this design to a practical operating unit.

Many techniques must be studied for forming a great variety of electronic materials with varying compositions and geometries.

Various thin film forming, diffusion, micro-machining and deposition techniques must be investigated. Finally, it is necessary to study the combination



SOLID-STATE CIRCUIT, one of several developed by Texas Instruments, consists of a tiny silicon wafer which is fabricated to function as a phase-shift oscillator. The program, originally started with the company's own funds, now is backed by Air Force sponsorship.

of a variety of such techniques and materials to create FEBs.

Work in this area is being carried out by Ohio State University and the Burroughs Corp., under Air Force sponsorship.

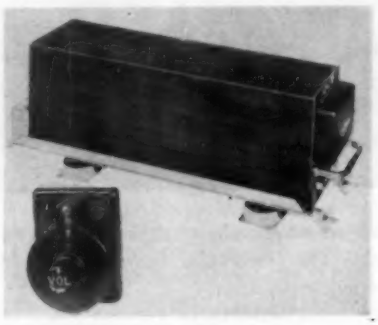
Although we have established a foundation for rapid advancement of applied research in the development of molecular electronics, we must be ready to capitalize on any new trend or concept which can improve our weapon system capability and reduce complexity.

New Concepts

Although many industrial and research organizations are doing work bordering on the areas in which we are interested, Westinghouse Electric and Texas Instruments were among the first to bring forth new concepts to exploit certain semiconductor and other solid state technology toward immediate application for many types of weapon systems. Earlier articles in AVIATION WEEK have described both company's programs (April 13, p. 75; April 27, p. 54).

Air Force contracts with Westinghouse and Texas Instruments are expected to yield a variety of functional electronic blocks, including audio amplifiers, tuned amplifiers, infrared sensors, variable potentiometers, multiposition switches, analog-to-digital converters, video amplifiers and multivibrators.

These are part of the broad Air Force research and development program aimed at molecular electronics, and the solution to the size, weight, power and reliability problems we face.



HF Transceiver

Lightweight high frequency radio transceiver, weighing only 15 lb., provides 20 crystal-controlled channels by means of remote selector in the HF band of 2 to 10 mc. Transmitter output is 35 w. minimum on all channels, providing ranges of 1,500 mi. and more. Manufacturer: Electronic Devices Corp., Coral Gables, Fla.

Aeronutronic Builds Ferrite Element

Los Angeles—New development in high speed computation employing a magnetic computer element capable of multi-megacycle performance in logical networks and memory arrays was introduced here recently by the Aeronutronic Division of Ford Motor Co. Company designation of the unit is Biax.

Developed by Aeronutronic, Biax element is a small rectangular bar of ferrite magnetic material measuring 50 by 50 by 85 mils. It is relatively inexpensive and can replace more expensive semiconductor devices such as transistors and diodes, according to Aeronutronic. Two configurations—one a memory element, the other a logic device—have been developed and are now being mass produced.

Biax elements can be used in a number of types of computing equipment for both military and commercial applications, including missile and satellite installations, language translation, library searching, decoding, and com-

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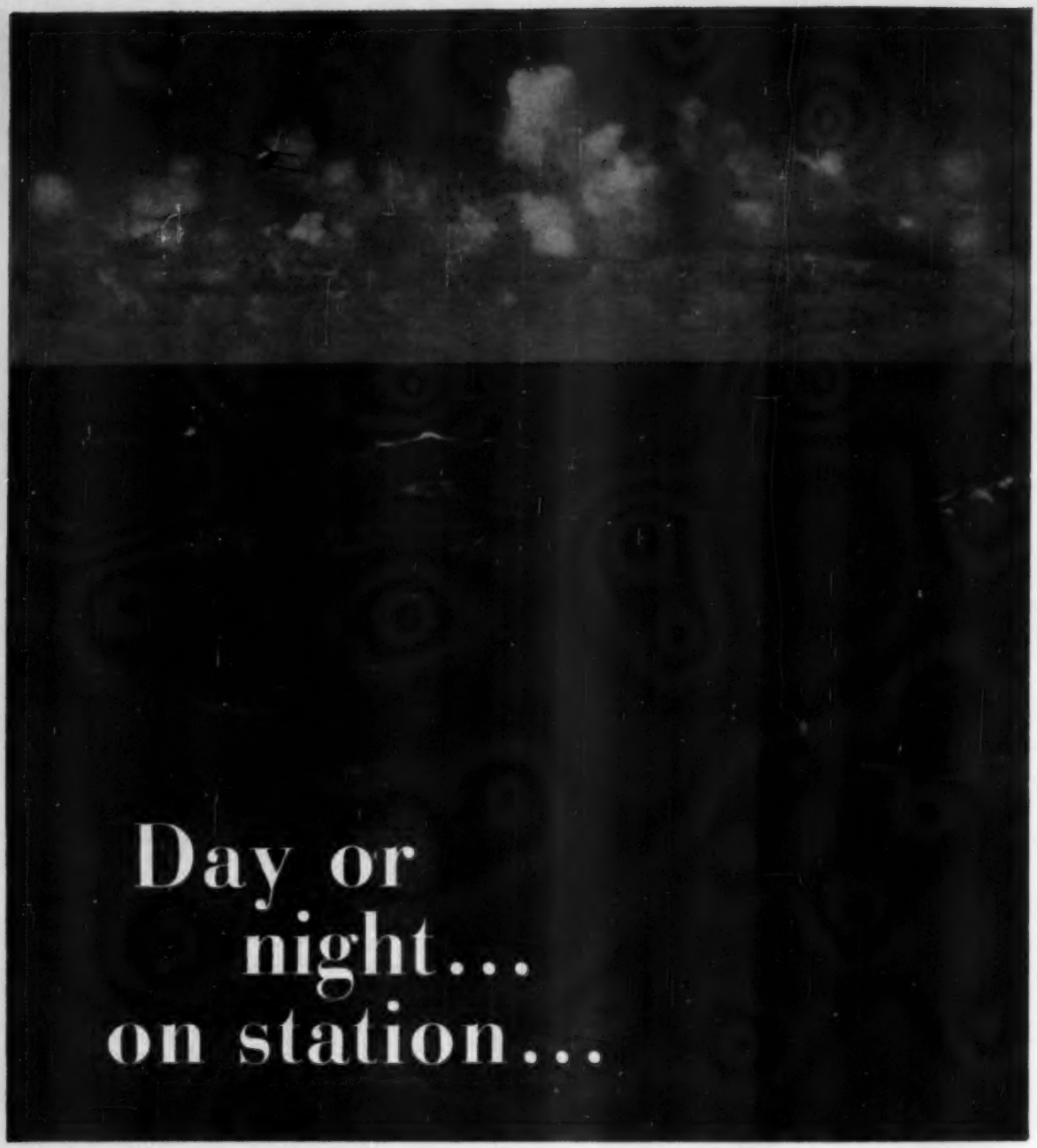

Somewhere at sea, crews of U.S. military patrol aircraft are intent on preventing a surprise attack by enemy bombers. Critical to the success of this patrol network is continuous knowledge of position and attitude.

For all missions of long flight times, Autonetics has developed and produced stellar-monitored inertial navigation systems of maximum accuracy and reliability. These systems make use of periodic starlight information... day or night... to correct for the gyro drift inherent in all pure inertial systems.

Autonetics stellar-inertial subsystems are now being produced for the advanced supersonic B-70 bomber, and to meet requirements for AEW... BMEW... reconnaissance... and tanker aircraft.

Stellar-Inertial navigation by Autonetics

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INERTIAL NAVIGATION / ARMAMENT CONTROL / FLIGHT CONTROL / COMPUTERS AND DATA PROCESSING

puting for calculating flight trajectories for rockets and missiles.

Reliability of Biax elements is high because of the basic passive nature plus its general rugged physical nature and insensitivity to temperature. A memory array has been operated for eight hours at 125C.

High speed operation up to 20 mc. per sec. has been achieved using the elements. Operational memory circuitry and logical circuitry have been fabricated and operated at two megacycles.

Aeronutronic is currently applying Biax techniques to airborne and ground-based military projects where multi-megacycle data processing is required. The company reports that it now has five contracts utilizing Biax elements.

Development program which resulted in the Biax high speed digital components was initiated several years ago by Aeronutronic's Computer Operations Research Laboratory.

FILTER CENTER

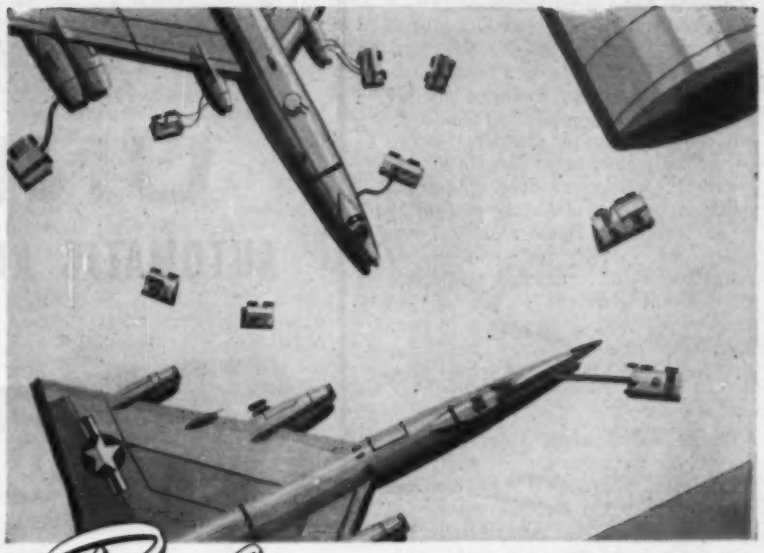
▶ **AIL Gets Molectronic Contract**—Airborne Instruments Laboratory will develop and fabricate a molecular electronic radio-frequency amplifier for use as a low-noise front-end for an existing telemetry system operating in the 2,150 to 2,350 mc. band. Design objectives call for minimum gain of 20 db., minimum bandwidth of 4 mc., a noise factor of less than 0.5 db. and rapid tunability over the band. Project is sponsored by WADC under a $232,310 contract.

▶ **NASA Considers Navigation Satellite**—More than half a dozen companies have discussed ideas for civil navigation satellites with representatives of National Aeronautics and Space Administration in recent weeks. However, NASA has not yet decided whether to launch a civil navigation satellite development because of current military program sponsored by ARPA (AW June 22, p. 143).

▶ **Search-Rescue Satellite** — National Aeronautics and Space Administration has started contract negotiations with Space Electronics Corp. for preliminary design of a search-rescue satellite. For details on the device, see AVIATION WEEK, June 29, p. 73.

▶ **Air Collision Device Tests Soon**—Bendix Radio is installing feasibility test models of its cooperative anti-collision warning system on company airplane and hopes to begin initial flight tests within the next month or two.

▶ **Split Personality**—Air Force Missile Development Center has devised and



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built a novel "data assimilator" which enables its two Univac Scientific 1103-A digital computers to receive and process telemetry data from missiles on a real-time basis by working as a team. Data assimilator includes a common memory in which data partially processed by one computer can be stored for pickup by second computer to complete computation. Another element of data assimilator, called a "loading platform," is an additional memory device into which data is fed independently of computer control. Data may come from 32 different channels at rate of 750 samples per second per channel. Data assimilator was designed and constructed by AFMDC's Computer Electronics Section.

► **Long-Lived Sputnik Power**—Soviet's Sovetskaya Aviatsiya reports that solar cells aboard Sputnik III have now operated over 8,000 hr., an average of 18 hr. per day while satellite is in the sun, since it was launched on May 15, 1958. Chemical batteries, which power Sputnik III's radio when it is in the earth's shadow, have operated for about 2,600 hr.

► **New Navy Preferred Circuits**—First supplement to original Navy Bureau of Aeronautics Handbook of Preferred Circuits, which describes five instrument servomechanisms, two voltage regulators, two high-voltage power supplies, a silicon transistor video amplifier and a pulse automatic frequency control, is now available from Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. The 106-page Supplement No. 1, identified 16-1-519, prepared by National Bureau of Standards, is priced at 60 cents. Foreign orders should include an additional 20 cents for mailing.

► **Catalog of Computer Reports**—New catalog of technical reports which lists all reports in field of computers available from Commerce Department's Office of Technical Services is now available from that agency in Washington for 10 cents. Ask for CTR-371, "Computers, 1937-58."

► **Signed on Dotted Line**—Major contract awards recently announced by avionics manufacturers include the following:

• **Summers Gyroscope Co.**, Santa Monica, Calif., $980,000 from Convair's Pomona Division for gyros to be used in Terrier and Tartar missiles.

• **Radio Corp. of America**, $2.4 million from Army Signal Supply Agency for continued work in development of Micro-Modules.

• **The Siegler Corp.**, Hallamore Electronics Division, Anaheim, Calif., $100,000 from Sperry Utah Engineer-

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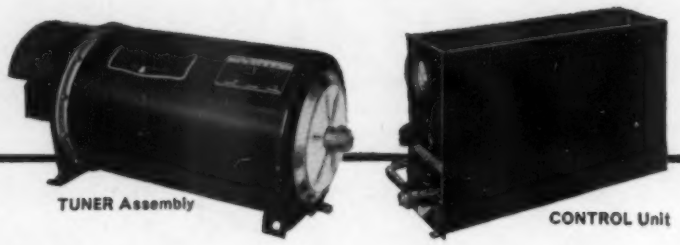
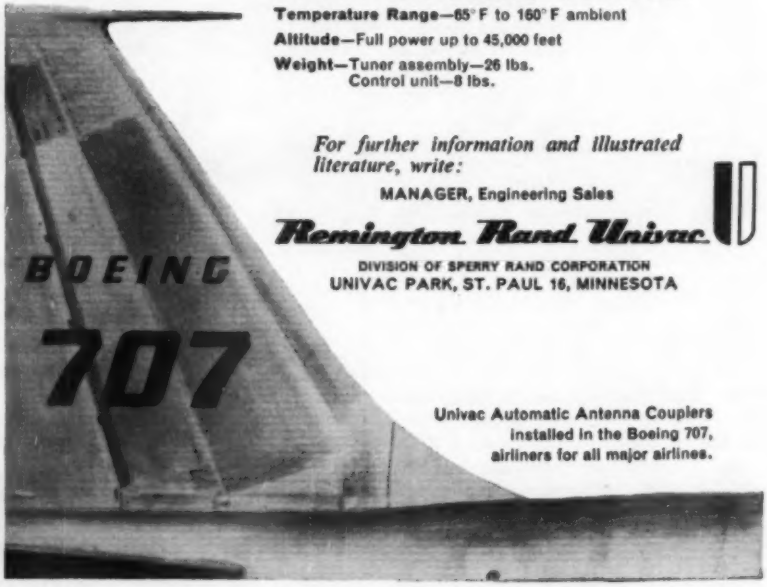


THE NEW UNIVAC 3200 SERIES:

- Designed especially for jet aircraft communications.
- Created by the same engineering staff which produced the first high altitude Automatic Antenna Coupler.
- The product of an extensive research program, backed up by more than six years experience in the engineering, manufacture and field support of over 5,000 automatic antenna couplers.
- Manufactured by Remington Rand Univac . . . a company with more experience in building automatic antenna couplers for jet aircraft than any other in the world.

Frequency Range—2-25 Megacycles, continuous
Tuning Accuracy—VSWR less than 2:1
Tuning Time—4 seconds average
R. F. Power Handling Capacity—Up to 1000 Watts
Temperature Range—65° F to 160° F ambient
Altitude—Full power up to 45,000 feet
Weight—Tuner assembly—26 lbs.
Control unit—8 lbs.



For further information and illustrated literature, write:
MANAGER, Engineering Sales
Remington Rand Univac
DIVISION OF SPERRY RAND CORPORATION
UNIVAC PARK, ST. PAUL 16, MINNESOTA

Univac Automatic Antenna Couplers installed in the Boeing 707, airliners for all major airlines.

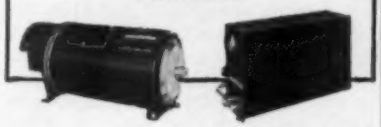
COMMUNICATIONS ENGINEERS

Investigate Opportunities

In the

UNIVAC®

AUTOMATIC ANTENNA COUPLER PROGRAM



Remington Rand Univac has immediate openings for electrical engineers for the development and design of airborne communications equipment. These are permanent positions in our St. Paul Laboratories, brought about by an expansion of developmental projects in the area of communications. Univac offers excellent potential for professional growth, together with company career opportunities.

QUALIFICATIONS: Electrical Engineering degree with a minimum of three years experience in one or more of the following fields: antenna couplers, H.F. transmission, network theory, airborne electronic equipment.

Salaries commensurate with experience; company-paid relocation expenses; liberal employee benefits. You and your family will enjoy the climate and recreational advantages offered by Minnesota and the Minneapolis and St. Paul community.

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Test Engineering

If you have applicable experience, we invite your inquiry. All correspondence will be handled promptly and in complete confidence. Send inquiry and resume of education and experience to:

R. K. PATTERSON, Dept. A-9

Remington Rand Univac

DIVISION OF SPERRY RAND CORPORATION
UNIVAC PARK, ST. PAUL 16, MINNESOTA

ing Co. for test equipment for Army Sergeant surface-to-surface missile.

• **Bendix Radio,** two contracts totaling $5.3 million from Rome Air Materiel Area for modification kits to update ground controlled approach and continental air defense radar systems.

• **Applied Science Corp.** of Princeton (ASCOP), $794,000, for digital data transmission systems to be installed at new Eglin Gulf Test Range in Florida.

• **Intercontinental Electronics Corp.,** Mineola, N. Y., $185,379 from Army Signal Supply Agency for scan conversion equipment to provide bright TV type radar displays.

• **W. L. Maxson Corp.,** $800,000 USAF contract to fabricate and test a flyable model of the AN/APS-99 (XY-1) bombing-navigation radar. System is scheduled for delivery next June.

• **Polarad Electronics Corp.,** $2.2 million in defense contracts, including Air Force award for electronic countermeasures receiver, automatic ground checkout equipment for B-58, and Navy contract for microwave signal generators.

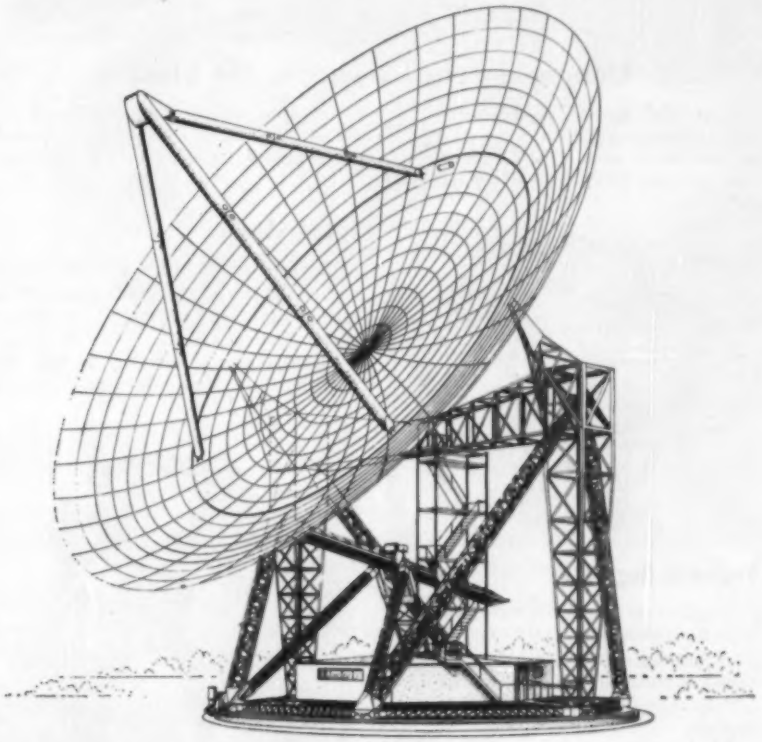
• **Hoffman Laboratories,** Los Angeles, $5 million Air Force contract for Tacan beacon simulators and portable Tacan test equipment. Production will continue through 1960.

• **Avion Division** of ACF Industries, Inc., Paramus, N. J., $600,000 contract from Radio Receptor Co. for radar beacons to be used on Army's SD-1 battlefield surveillance drone.

• **Hughes Aircraft Co.,** Fullerton, Calif., $7.3 million contract from Army for 12 months' development work "to improve the Missile Monitor anti-aircraft defense system."

• **Martin Co.,** Orlando, Fla., $1.9 million Army contract for fire integration equipment to be used with Missile Master.

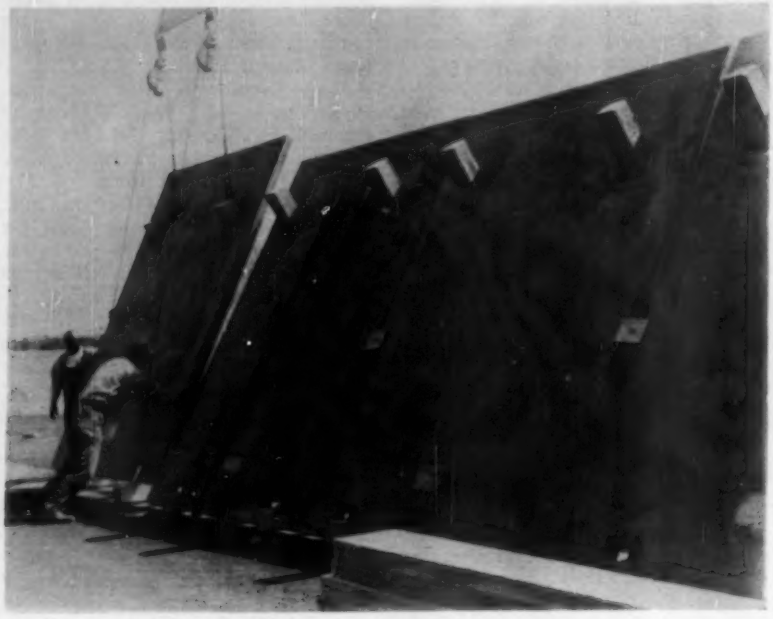
• **Telecomputing Corp.,** Los Angeles, contracts totaling $260,000 for new extremely accurate camera film readers to analyze missile data and convert it into digital form, for installation at White Sands Missile Range.



Radar Telescope Designed to Probe Space

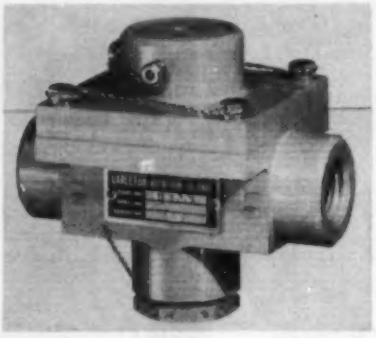
Powerful radar telescope for probing interplanetary space and measuring cosmic distances will be constructed at Stanford University during coming year. The 142 ft. diameter parabolic antenna will be largest in the U. S. It can be used at frequencies between 20 and 2,000 mc. Transmitter, which will have a million-watt power supply, will operate in the 20-60 mc. region. Radar telescope will be used to determine rotational speed of Venus, whose surface is shrouded by perpetual fog, and to measure ionization density and distribution in sun's outer corona and around the planets. Stanford Research Institute and Stanford University will share facility. Project is sponsored by Air Force Cambridge Research Center.

NEW AVIATION PRODUCTS



Concrete Fence Deflects Jet Blast

Concrete blast deflector fence is erected near Trans World Airlines' hangars at San Francisco International Airport. Concrete slabs, measuring 3 in. x 8 ft. x 10 ft., are supported by concrete A-frames. The 536 ft. fence protects a parking lot and auto driveway from blast of Trans World Airlines' jet transports.



Pressure Regulator

Single-stage miniature pressure regulator for life support systems in the space environment will be used on the National Aeronautics and Space Administration Project Mercury man-in-space capsule.

Model 1400 regulator weighs 8 oz. and handles 10,000 psi. pressure. Other specifications include: 2.4 lb./min. flow, 100 + or −10 psi. outlet pressure, 16,700 psi. proof pressure, 22,000 psi. burst pressure. Regulator is applicable to helium, nitrogen and other gases, in addition to its present use on oxygen systems.

Carleton Aviation Co., Inc., E. Aurora, N. Y.

Speed Sensor

Flexure speed sensor provides pneumatic control of speed for gas and air turbine motors, starters, compressors and shaft power units.

Speed control, installed in the output shaft of the power unit, gives a

pneumatic signal as a function of centrifugal force predetermined at any given rpm. Sensor has virtually no hysteresis, zero calibration shift, and no flyweights or hinge points.

AiResearch Manufacturing Division, 402 S. 36th St., Phoenix, Ariz.

Missile Gas Drier

High pressure gas drying system is intended for missile ground support installations where moisture-free gas is needed.

System consists of a drier, a hygrometer moisture indicator and a Corbin diaphragm-type compressor mounted on a common base or as separate components.

Drier is an automatic dual assembly, one side of which dries gas while the other is reactivated. Molecular sieve drying agents dry gases to dewpoints as low as −100F. The compressor operates by hydraulically pulsed diaphragms which separate the gas from the lubricants.

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.

Angle of Attack Transmitter

Angle of attack transmitter for high performance aircraft provides visual or remote information for fire control and/or flight control systems. Functional accuracy from 120 kt. to Mach 3 is 0.2 deg. at sea level.

Model 2562A-3 transmitter's vane drives two synchros through a gear train multiplication of 2.7 to 1 and provides a 26 v., 400 cps. output. Instruments can be supplied with a potentiometric differential transformer or else a simple switch output, and with any desired gear ratio.

The unit weighs less than 2 lb. and meets Air Force specification MIL-T-25627.

Giannini Controls Corp., 918 E. Green St., Pasadena 1, Calif.

SQUEEZING FLUOROFLEX-T

...to make better Teflon® hose!

Resistoflex developed a unique method of quality control called "roll testing" prior to the introduction of Fluoroflex®-T in 1953. This torture test, in which the tubing is compressed in multiple planes, helps to insure the homogenous quality of the hose.

Long experience with "roll testing" is only one of many reasons for the dependable performance of Fluoroflex-T hose. Pneumatic pressure testing—and other control methods developed by Resistoflex—are now being written into industry specifications as "standard" requirements for high quality hose products.

However, for the best in Teflon, fabricating experience is the most important ingredient. With more than 3,000,000 assemblies in service, the reliability of Fluoroflex-T is proven. Designers of hydraulic, fuel, pneumatic and ballistic components *know* they can depend on Fluoroflex-T.

For more information write to Dept. 298, RESISTOFLEX CORPORATION, Roseland, New Jersey.

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Originators of high temperature fluorocarbon hose assemblies.

Resistoflex

ROSELAND, NEW JERSEY • WESTERN PLANT: BURBANK, CALIF. • SOUTHWESTERN PLANT: DALLAS, TEX.

Meet your needs for LONG FLEX LIFE with hose of Du Pont TFE resins

Hose lined with TEFLON TFE resin, with its long flex life and resistance to heat and corrosion, found many applications in the fuel and hydraulic systems of Lockheed's prop-jet ELECTRA.

Hose lining of TEFLON TFE-fluorocarbon resins displays excellent endurance under conditions of continuous flexing, torque and vibration. This is just one of the ways in which the unique combination of properties offered by TFE resins can help you meet the rigorous requirements imposed on hose lines by modern flight equipment. TFE resins are rated for continuous use up to 500°F. Its toughness and flexibility permit the construction of lighter-weight hose for equivalent pressure ratings, with the resulting valuable weight saving. With overbraiding, hydraulic line pressures up to 6,000 psi are being achieved. TEFLON is unaffected by all fuels, oils and hydraulic fluids, an important factor in safety and reduced maintenance.

Little wonder that hose lined with TEFLON TFE resins is standard equipment for fuel and hydraulic lines in many modern aircraft. Why not find out more about the properties of these unique resins, and how they can provide maximum safety and reliability with minimum weight and maintenance in your hose lines? Write to your local supplier or E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Dept., Room 87, Du Pont Building, Wilmington 98, Delaware.

In Canada: Du Pont of Canada Ltd., P.O. Box 660, Montreal, Quebec.

TEFLON is Du Pont's registered trademark for its fluorocarbon resins, including the TFE (tetrafluoroethylene) resins discussed herein.

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TFE-FLUOROCARBON RESINS

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

SAFIR 91D has a top speed of 168 mph. and is suitable for military or civil training without any modifications.

Aviation Week Pilot Report:

Saab Safir 91D Has Sport, Military Uses

By Robert I. Stanfield

Paris—Inherently rugged, due to its military design requirements, the fully aerobatic four-place Saab 91D Safir is a responsive, stable airplane that can carry a full payload—four passengers, plus 110 lb. of baggage—at maximum fuel.

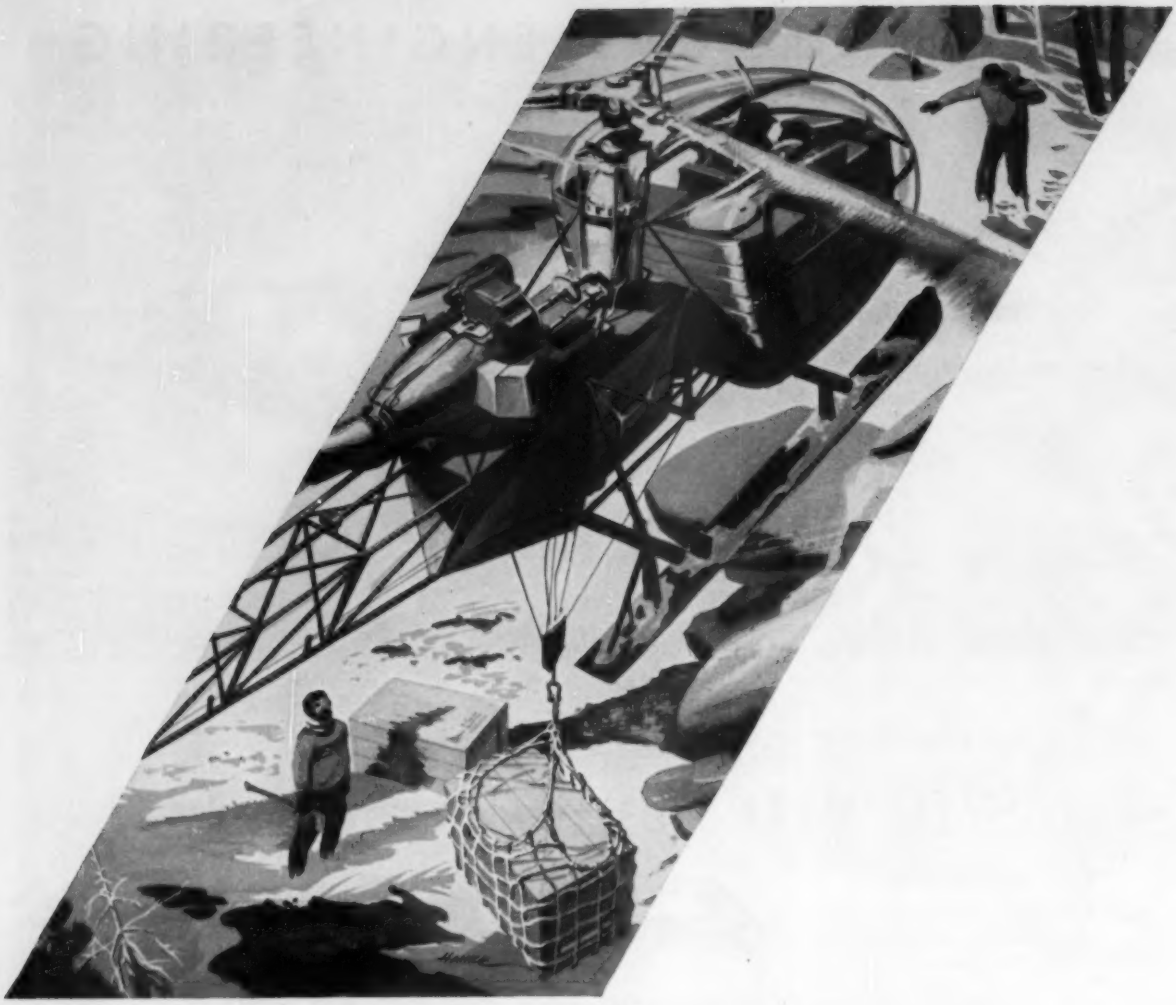
The versatile, Swedish-built all-metal 91D, evaluated by AVIATION WEEK at the Paris air show, is the latest in a series of which about 220 airplanes have been built to date. The Safir—91A through 91D—is operating in 18 countries as a side-by-side military or commercial trainer as well as a sport-executive airplane.

The 91D is powered by a Lycoming four-cylinder 0-360-A1A horizontally opposed air-cooled engine, developing 180 hp. at 2,700 rpm. at sea level. Fuel grade is 91/96 octane. Propeller is McCauley, all-metal constant-speed (Hartzell propeller is optional). Top speed is 168 mph. Range is 700 stat. mi. at 66% power.

Cost of the tricycle-geared Safir 91D, with standard instrumentation exclusive of optional radio-navigation equipment, is approximately $20,000. The airplane is built at the Linkoping, Sweden, factory of Svenska Aeroplan Aktiebolaget (Saab Aircraft Co.).

Main difference between the 91D

FLIGHT instruments, for instructional purposes, are located on both sides of this 91D instrument panel. Center quadrant holds levers for gear, flaps, elevator trim.



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MODERN PIONEER OF THE FAR NORTH

Newest bird in the wilds of Alaska and northern Canada is the Alouette, world's first production turbine-powered helicopter. In once-inaccessible corners of our 49th State, as well as in wilderness areas of Canada, the Alouette is doing "impossible" jobs with a minimum of fuss and feathers. As a passenger craft, a utility workhorse, a fire-fighter, an ambulance, and in any role it's called on to fill, the Alouette does its work efficiently, quickly, economically. The Alouette is performing yeoman service for a wide range of industries.*

- *Greatest fuel flexibility: uses JP-1, JP-4, 640 Kerosene, or Diesel*
- *Instant take-off*
- *Simplified controls*
- *Instantaneous power response*
- *Low maintenance time to flight time*
- *Top performance in extreme hot or cold weather*

**Designed by Sud Aviation of France*

THE ALOUETTE IS ASSEMBLED, TESTED AND DISTRIBUTED BY:

REPUBLIC AVIATION CORPORATION

HELICOPTER DIVISION

FARMINGDALE, LONG ISLAND, N. Y.

Saab 91D Safir

Specifications:

Wing span	34 ft. 9 in.
Wing area	146 sq. ft.
Aspect ratio	8.3
Length	26 ft. 4 in.
Height (on ground to top of fin)	7 ft. 2.6 in.
Propeller ground clearance	1 ft. 3.4 in.
Wheel track	5 ft. 10 in.
Wheel base	5 ft. 2.2 in.
Cabin width (internal)	4 ft.
Empty weight	1,570 lb.
Gross weight	2,660 lb.
Wing loading	18.2 lb./sq. ft.
Power loading	14.8 lb./Bhp.
Fuel capacity	42.3 gal.
Oil capacity	2 gal.

Engine: Lycoming O-360-A1A horizontally-opposed, four-cylinder, air-cooled rated at 180 hp. at 2,700 rpm. at sea level.

Propeller: McCauley constant speed, ungeared. (Hartzell propeller is optional.)

(which first appeared in 1957) and its predecessors is the lighter, four-cylinder engine of the D, as compared with the six-cylinder 190 hp. Lycoming 0-435-A that powers the B and C models. Additions to the 91D include its constant-speed propeller and propeller spinner, increased generator output, modified air intake and new wheel brakes of Goodyear single-disk type.

Performance of all models at the same useful load is about the same, but reduction in empty weight of about 45 kg. (99 lb.) allows a larger margin for optional equipment or luggage in the 91D.

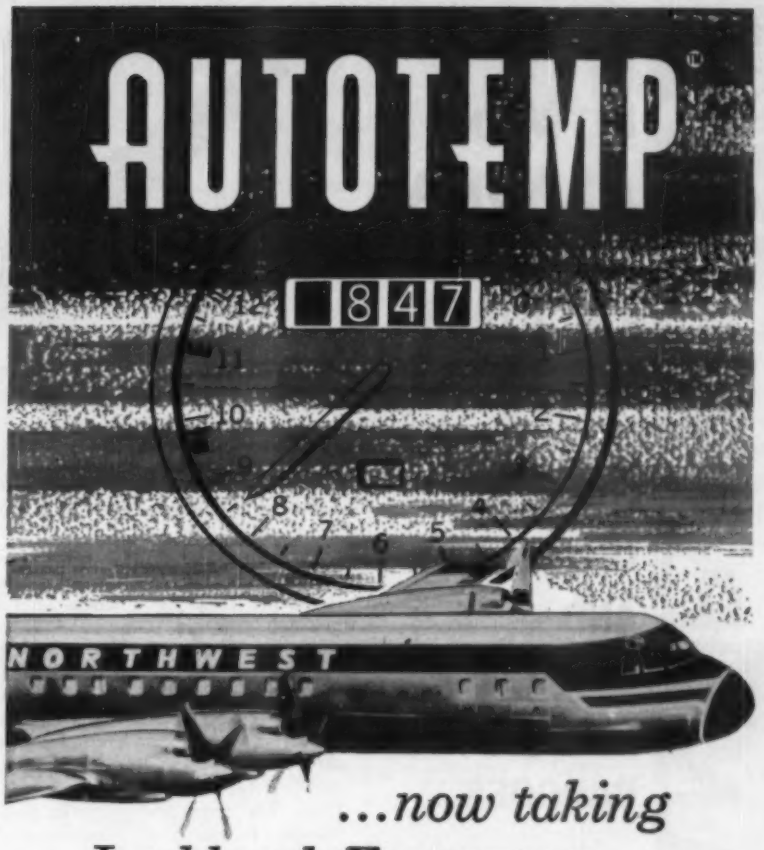
Clean Design

The Safir is a handsome airplane, clean in design, built of aluminum alloy sheet with stressed skin construction. Single-spar wings feature a pronounced washout, allowing for good stall characteristics. Easily detachable wings are joined to the fuselage by two bolts each. Both wings contain flexible fuel tanks. Wing landing lights are dual.

Construction includes automatic couplings for fuel pipe lines, aileron control rods, flap shaft and pitot tube connections. Rudder, elevator, ailerons and the rear part of the wings are fabric covered. Electrical system is composed of an engine-driven d.c. generator, 24 v., 25 amp. Battery is 24 v., 24 amp./hr.

Airplane sits low enough for ground-level maintenance. Petal-type cowl sections hinge upward from each side, for convenient access to engine and oil filler neck. Lower section of cowling hinges downward, to the rear. Fuel is serviced over the leading edge of the wing.

Entrance is via wing walk-up, on either side of the airplane, as the full Plexiglas canopy hinges upward from



...now taking
Lockheed ELECTRA'S
temperature...to 1°C.

High accuracy, and easiest *needle pointer plus digital in-line counter readout,* are the principal service features of the BH183 AUTOTEMP® jet engine temperature indicator.

AUTOTEMP is designed and produced by the makers of the JETCAL Analyzer®, the only jet engine tester used throughout the world.

The AUTOTEMP is a completely new instrument...a continuous null balance 144-inch slidewire potentiometer combined with a linearizing analog-to-digital converter. Its accuracy is the simple attribute or phenomenon of its novel and basic slidewire potentiometer!

Completely self-contained...transistorized, miniaturized, hermetically sealed, servo-driven...the AUTOTEMP'S 3"-diameter case includes a Zener reference, power supply, amplifier, servo motor, cold junction compensation and the 144-inch slidewire and punched tape to linearize thermocouple e.m.f. for exact, counter-type digital readout. The needle pointer indicates in 50°C increments over the 0 to 1200°C full range of the unit.

Full information is contained in our Bulletin BH183 available for the asking!

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SAFIR has a wing span of 34 ft. 9 in., length of 26 ft. 4 in. Wing area is 146 sq. ft.

both sides. The right front seat and one or both rear seats can be removed for either cargo or a single stretcher installed instead of the two right-hand seats. The interior covering is washable. Seats will take either seat cushions or seat parachutes. The luggage rack is located aft of the rear seats.

Seating in the Safir is quite comfortable, the large glass area affording good visibility for all occupants in all directions. The upper portion of the all-glass canopy features an accordion-folded curtain which can be utilized as necessary.

Saab favors the side-by-side pilot-trainer seating, which the company feels ensures against student-instructor misinterpretations that crop up in tandem-type trainers. Dual flight controls, standard equipment, are stick type. Center quadrant, between pilots' seats, holds levers for mechanically retracted gear and flaps, and elevator trim.

91D Instrumentation

Flight instruments are located on the left side of the main panel. Engine instruments are centered and radio controls located to the right. Arrangement is flexible; ample space is provided for installation of extra and optional equipment.

Standard engine instruments include a tachometer, fuel pressure warning light, cylinder temperature gage, and gages for fuel, oil pressure, oil temperature, and manifold pressure. Standard flight instruments include a sensitive altimeter, airspeed, rate of climb, turn and bank, magnetic compass, clock and stall warning light.

Optional Equipment

Dual set of flight instruments can be installed for training and/or instrument flight. Optional equipment includes VHF radio, radio compass, directional gyro and artificial horizon.

Aircraft flown in evaluation was number SE-CGZ. Accompanying this Aviation Week pilot was Ceylon Utterborn, Saab experimental test pilot who demonstrated the double-delta Draken at the Paris air show (AW June 29, p. 20). With two of us aboard, plus a full fuel load, the 91D grossed out at about 2,250 lb.

The engine started quickly, and the airplane was easily maneuvered across the grass area and onto the paved taxi strip. Rudder pedals are linked to steerable nose wheel. Field elevation at Le Bourget is 180 ft. Sea level pressure was 1015 mb. Outside air temperature was 20C. Wind at takeoff was from

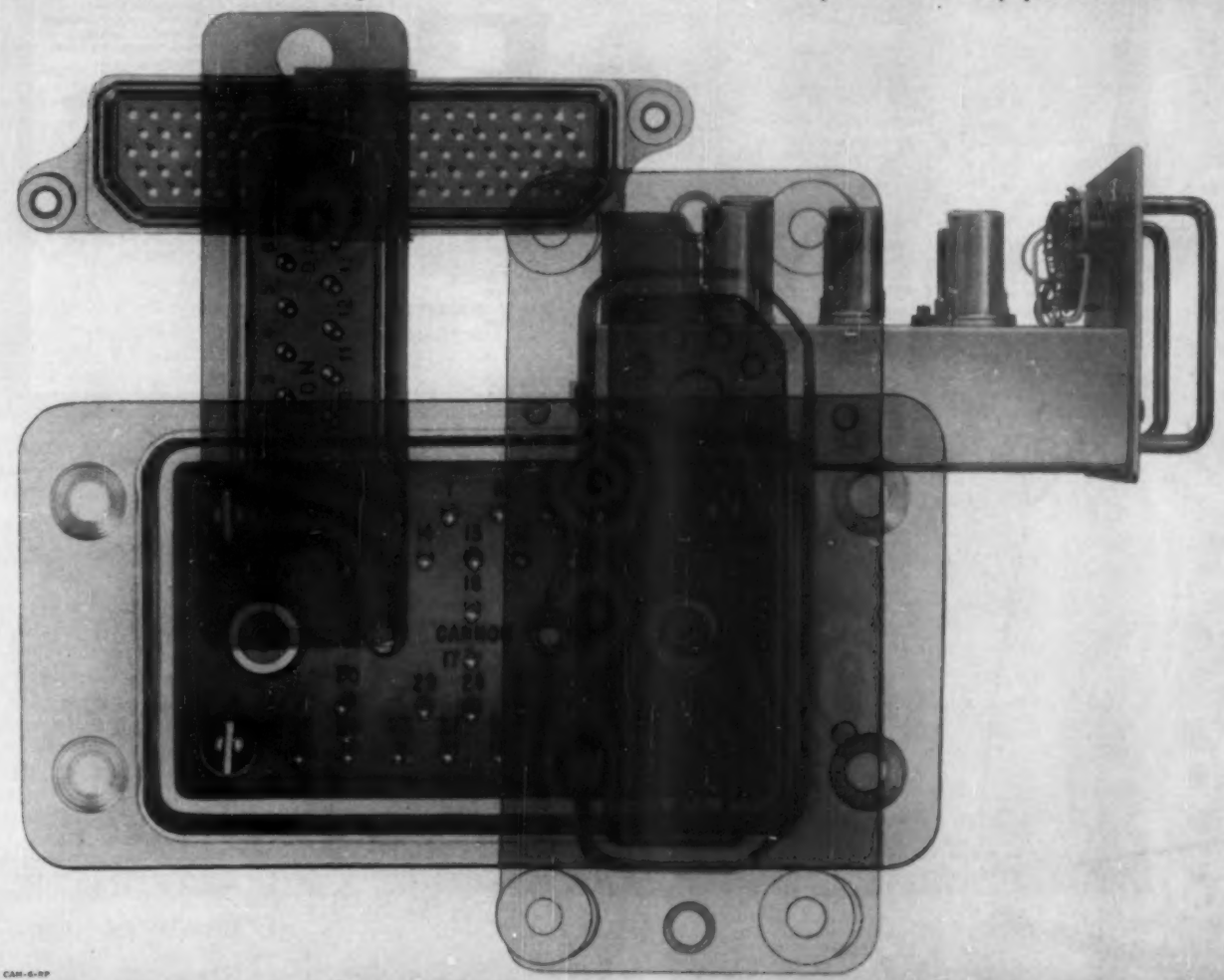
Saab 91D Safir

Performance:	At 2,315 lb. (Aerobatic)	At 2,660 lb. (Gross weight)
Speeds (sea level):		
Maximum	168 mph.	165 mph.
Maximum cruise (75% power)	149 mph.	146 mph.
Economical cruise (66% power)	140 mph.	137 mph.
Range (5,000 ft. at 66% power)	700 stat. mi.	660 stat. mi.
Rate of climb (sea level)	985 fpm.	800 fpm.
Service ceiling	20,000 ft.	16,400 ft.
Takeoff (over 50 ft. obstacle)	1,310 ft.	2,030 ft.
Landing (over 50 ft. obstacle)	1,670 ft	1,800 ft.

CANNON PLUGS

The assembling of highly-flexible electronic systems and subsystems into a modular package . . . for fast inspection, testing, service, and replacement of components . . . calls for standardized-type plugs throughout the system. Reliability and optimum flexibility in shell designs and types of layouts are the design criteria for the more than 18 different basic Cannon Modular and Rack/Panel Plug Series. This Series is available in standard, miniature, or subminiature sizes . . . for standard or printed circuitry. Up to 180 contacts and a varied combination of contacts for control, audio, thermocouple, co-ax, twin-ax, and pneumatic connections. Single or double-gang. With or without shells. The Rack/Panel Series ranges from the tiny "D" subminiature to the heavy-duty DPD Rack/Panel Plug. For further information on Cannon Modular and Rack/Panel Plugs write for Cannon DP Catalog, Cannon Electric Co., 3208 Humboldt St., Los Angeles 31. Please refer to Dept. 110, Factories in Los Angeles, Santa Ana, Salem, Toronto, London, Paris, Melbourne, Tokyo. Distributors and Representatives in the principal cities of the world.

Maximum Flexibility for Modular and Rack/Panel Applications



CAN-6-RP

REFRASIL	METAL BLANKETS	ELECTRIC BLANKETS	THOMPSOGLAS	ASTROLITE	HITCORE
Highly efficient silica material for up to 2000° F. continuous, and higher temperatures for short duration use.	HITCO metal blankets consist of envelope of stainless steel, inconel or other metallic foil enclosing layer of insulating batt.	HITCO insulation Blanket with built-in heating elements, and thermostatic controls.	Molded high-density fiber glass for thermal, acoustical and vibration uses.	Consists of Refrasil fibers combined with high temperature phenolic resin binders for short duration use up to 15,000°F.	Structural core materials of stainless steel, titanium and other weldable foils, in honeycomb form. Hitcore is machine-made lightweight welded metal honeycomb core material.
PHYSICAL FORMS: • Batt • Bulk fiber • Cordage • Cloth • Sleeving • Tape • Yarn APPLICATIONS • Thermal and acoustical insulation • Insulation for jet engines, rockets and missiles • Industrial filtration • Electrical insulation	PRODUCTS: • Flexible metal covered insulating blankets • Pre-form metal covered insulating blankets APPLICATIONS: • Thermal and acoustical insulation • Rocket and missile insulation	APPLICATIONS To control temperature of critical components or fluid systems. HITCO is capable of designing Electric Blankets to meet your specific requirements, using HITCO custom-designed heating elements.	PRODUCTS: • Compression pads • Protective packaging liners • Ducting insulation • Thermal and acoustical insulation panels APPLICATIONS: • Packaging of delicate components • Aircraft, rocket and missile ducting insulation • Aircraft cabin insulation	PRODUCTS: • Rocket nozzle entrance and exit cones • Nose cones • Deflector vanes • Blast tubes • Combustion chamber liners APPLICATIONS: Re-entry and ablation uses for: • Rockets and missiles • Spacecraft • Earth satellites	APPLICATIONS: High temperature uses by sandwich-type structural panel manufacturers for aircraft and missiles.

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You, as a Missile or Space Flight Scientist and Engineer, are engaged in the world's most exacting technology requiring high temperature materials.

Your contribution to the advancement of the art sometimes depends upon the availability of materials which have extraordinary insulation ability.

HITCO is one of the world's leading developers and manufacturers of thermal materials capable of performing in temperature extremes from — 300° F. up to 15,000° F!

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the northeast at 10 kt., practically on the nose to Runway 3.

At full throttle—30 in. manifold pressure and 2,700 rpm.— the Safir moved quickly down the runway, flying itself off at 60 mph. with slight back pressure in about 600 ft. Climbout was made at full throttle at an indicated airspeed of 80 mph. Initial rate of climb was 1,000 fpm.

Noise level during climb was not excessive and control feel and response in turns were good. Climb angle at 80 mph. allowed for good forward visibility, as well as to the sides and rearward. A bit of trim allowed for hands-off flight.

Safir was leveled off at 3,000 ft. where at normal cruise—24 in. and 2,450 rpm. —the 91D indicated 125 mph. With outside air temperature 13C, true airspeed was 132 mph. At maximum cruise (75% power) the Safir will indicate 141 mph. Sea level maximum is 168 mph.

Control response was good during medium to steep banks, left and right. "Feel" of this airplane is not overly sensitive or too heavy, and only light control pressures are necessary. The Safir is the only piston-engined trainer used by the Swedish air force, where pilots put 18 hr. on the trainer before moving to the 500-mph. Vampire jet for an additional 100 hr. of training.

Military Development

The Safir also has played an important part in the development of Saab military jet aircraft. The low-speed properties of the Saab J-29's swept-back wing were established by flying a Safir fitted with a J-29 wing built to reduced scale. Same procedure was adopted with the transonic Saab-32 Lansen.

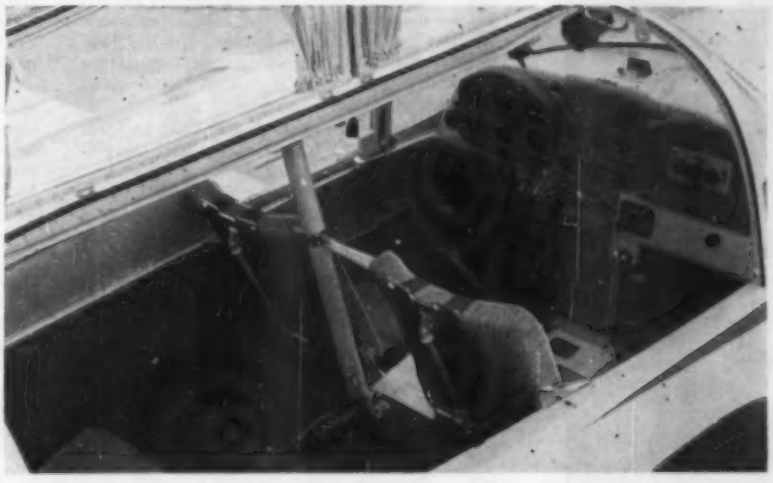
Airspeed of the 91D is red-lined at 215 mph. and yellow-lined at 162 mph. Without encroaching on limit or caution speeds, the airplane was slow-rolled at 140 mph. (best roll speed), followed by a series of loops and Immelmanns. The Safir was smooth and responsive throughout aerobatic flying, with no heavy power applications being necessary to "force" a maneuver.

Load limit g-factors of the 91D at 2,315 lb. (aerobatic category) are: maneuver—positive, 6; negative, 3; factor of safety, 1.5. The airplane fulfills regulations of the Civil Aeronautic Board's CAR Part 3, airplane airworthiness, as amended to May 15, 1956, category utility and acrobatic.

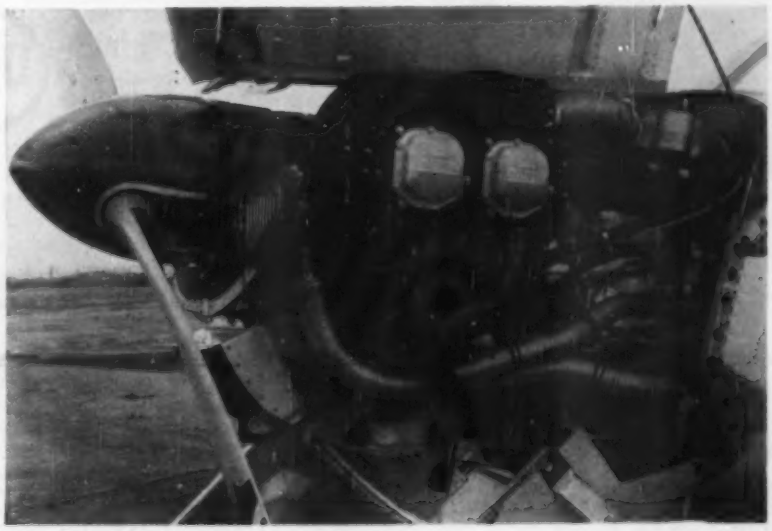
The airplane stalls reluctantly. In clean configuration—gear and flaps up —airspeed hit bottom of indicator (60 mph.) before the 91D docilely wallowed down, the nose picking up as speed increased. There was no tendency to fall off on a wing and altitude loss would be negated if power were applied.

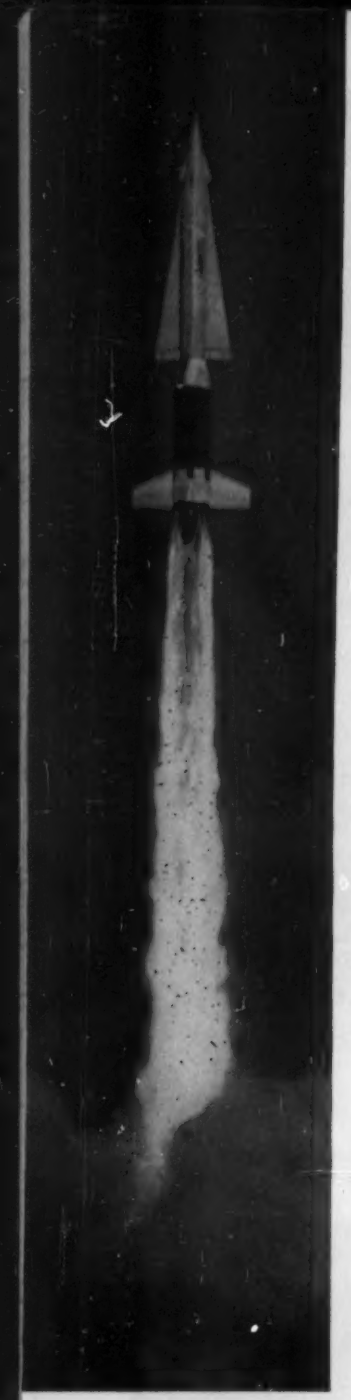
With gear and full flaps, the airspeed

SAFIR 91B is three-place. Power is supplied by six-cylinder Lycoming O-435-A of 190 hp.



INTERIOR of four-place 91D (above) is washable. Luggage rack is located aft of rear seats. Four-cylinder Lycoming O-360-A1A (below) develops 180 hp. at 2,700 rpm.





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That is why the development of USS AIRSTEEL X-200 is welcome news to missile and rocket makers. For here is a missile steel that develops its ultra-high strengths *without* cumbersome, time-consuming quenching procedures and so avoids the hazards of non-uniform strength, distortion and improper sizing that can plague the fabricator of large missile parts.

AIRSTEEL X-200 is the result of careful balancing of carbon, silicon, chromium, molybdenum and vanadium to create a steel that can be welded, is air hardenable and finally tempers at relatively high temperatures to provide consistent high strength. *Thus, a missile part can be shaped and welded in its soft condition, then heated, and cooled in air and tempered to develop its strength.* In this stage, Airsteel has a minimum yield strength of 230,000 psi and a tensile strength of 270,000 psi in sheet and light plate thicknesses.

Here is a missile material that has been spun, cold formed, deep drawn, rolled to form cylinders, and welded in exhaustive fabrication tests. Several major manufacturers are applying USS AIRSTEEL X-200 today as motor case material for solid fuel missiles. We invite your consideration of this new material, its high strength-to-weight potentialities, its overall ease of fabrication, to help solve your problems in missile manufacture.

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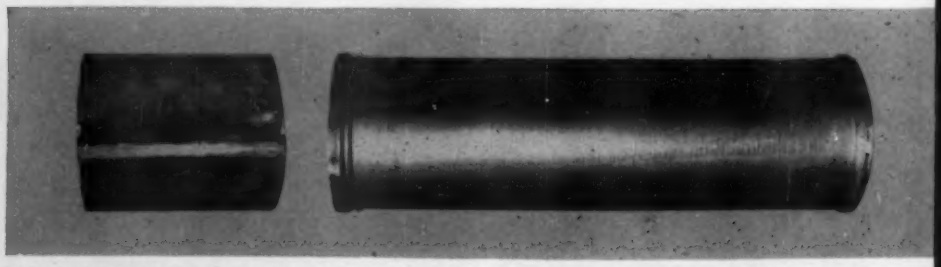


Proof of weldability and workability. *The small cylinder* was shaped and welded from annealed ¼-inch AIRSTEEL X-200 plate and spun into a long cylinder with 0.060-inch walls. The weld showed no cracking.

United States Steel, Room 2801, 525 William Penn Place, Pittsburgh 30, Pa.
Please send complete information on USS Airsteel X-200.

Name.....**Position**.....**Company**.....

Address.....**City**.....**Zone**.....**State**.....

reading again dropped to the bottom of the indicator, the airplane settled after stall warning and light buffeting, with no sharp breakaway. Ailerons and rudder are effective throughout whole of the stall (the airplane is quite responsive during slow flight), which is straightforward unless controls are set intentionally for a spin, from which recovery can be made by centralizing the controls.

Landing was preceded by an approach, with full flaps, of 80 mph., following which the airplane was turned off after a short landing roll. Spring counterbalance compensates for gravity and air loads on the gear; nose wheel is equipped with an anti-shimmy device.

First production version of the Safir —the 91A—was fitted with a British engine, the de Havilland Gypsy Major 10 of 145 hp. The 91A was introduced in the Swedish air force in 1947, as a liaison aircraft, and exported to civil customers through 1949. It was also used in Ethiopia as a military trainer.

The Safir currently is being offered in three versions, the three-place 91B and the four-place 91C and 91D. Production is at the rate of five per month, with deliveries about eight months following an order. Saab has not yet made any serious attempts to market the Safir in the United States, though it has an applicable marketing organization in Saab Overseas, Inc., in New York City.

The three-place 91B appeared in 1949, powered by a 190 hp. Lycoming O-435-A, and was utilized as a primary-basic trainer by the Swedish air force and the air forces of Ethiopia and Norway. The 91C, the first four-place Safir, is also powered by the O-435-A. Ten of the latter have been ordered by the Ethiopian military, and 14 by the Swedish air force.

Also currently on order, with deliveries underway, are 20 91Ds to the Finnish air force (which is negotiating for 10 more), and 18 91Ds to the Dutch Government's Civil Flying Training School (RLS) for the training of KLM pilots. Other airlines whose pilots are trained on Safirs include Lufthansa, Air France and Garuda Indonesian Airways.

The Safir is suitable for military or civil training without any modifications. Airplane to date has accumulated over 200,000 flying hours, according to Saab.

PRODUCTION BRIEFING

General Electric Co. plans construction of a commercial plant which will produce Lexan polycarbonate resin. Material is now being used to make translucent shield for lights in leading edge of Lockheed F-104 wing and shows some promise as a base for high temperature (600F) hydraulic fluids. Plant will be located near Mount Vernon, Ind., and is expected to be in production in the third quarter of 1960.

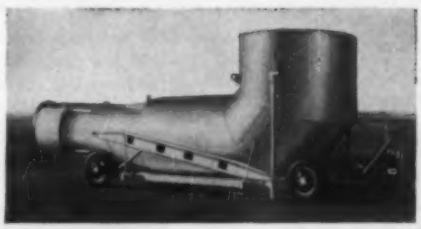
Additional "substantial" order for de Havilland Sea Vixen all-weather fighters has been received from the Royal Navy. De Havilland says the order will continue Sea Vixen production at its Christchurch factory to late 1961.

Elgin Micronics, a division of Elgin National Watch Co., Chatsworth, Calif., will produce safety-arming devices for the Navy's Sparrow air-to-air missile under $425,000 contract. The contract is the company's third on the Sparrow missile.

Cleveland Pneumatic Industries, Inc., will develop a prototype ship-to-ship transfer system for the Talos missile under Navy Bureau of Ships contract. The system, designated FAST (fast automatic shuttle transfer), will transport the Talos from a supply ship to a receiving device on the missile cruiser deck.

Lycoming Division, Avco Corp., Stratford, Conn. will produce solid propellant missile rocket chambers under a $6 million contract from Aerojet-General. The contract covers production of both second and third stage chambers for the Minuteman ICBM and chambers for the Polaris IRBM.

QUIET FOR JETS



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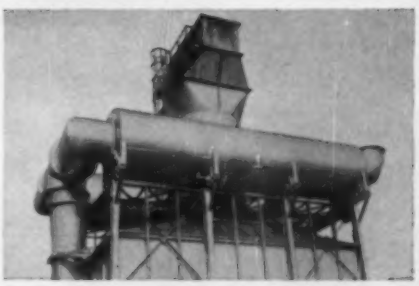
Model JEC-10 (shown) is designed specifically for the Douglas DC-8 and Boeing 707. This rugged unit affords a high degree of silencing — without using tie downs.



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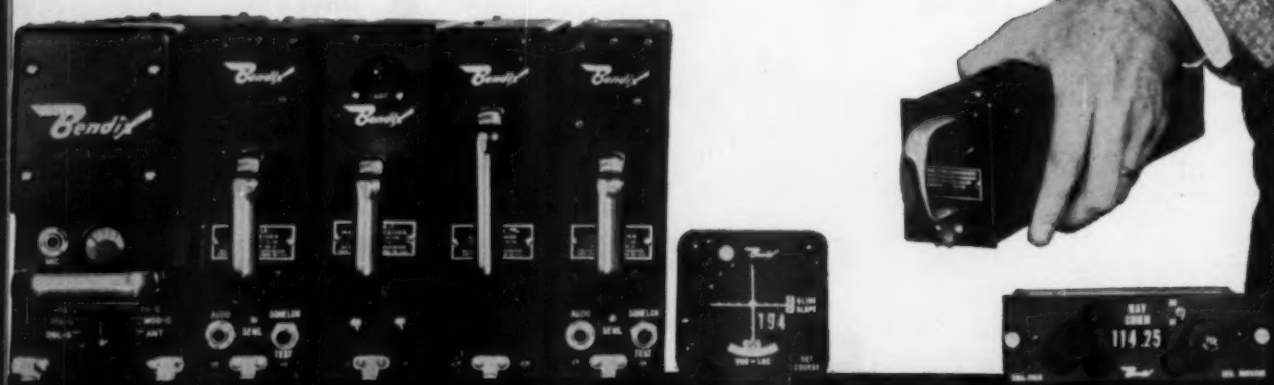
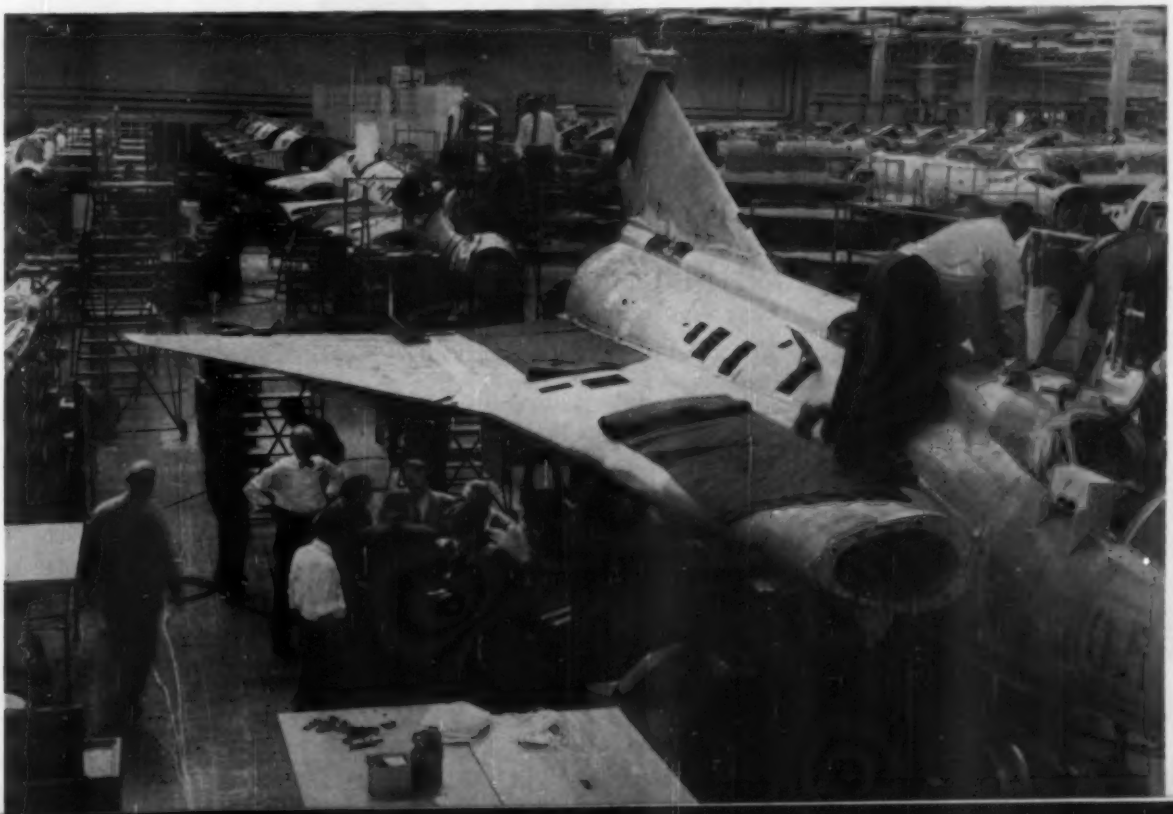


Fifth preproduction J35A Draken shows extension of tailpipe and redesign of rear fuselage.

Swedish Saab Draken Enters Full Production

First detailed photographs of major assemblies of the Saab J35 Draken show some of the production techniques previously described exclusively by Aviation Week (Mar. 31, 1958, p. 64). Swedish double-delta interceptor now is in full production for Royal Swedish Air Force. Latest version is J35B which features lengthened rear fuselage with full afterburner for Swedish-built Rolls-Royce Avon turbojet engine; area-ruling, and a tail wheel to take ground impacts at normal nose-high landing attitude. Forward section of the J35A (shown here) and the J35B, now entering its test program, are basically the same. Most of the structural components and all machine parts are made underground in machine shops and buildup areas blasted out of granite. Subassemblies are taken to the main assembly floor and started on production line.



Forward section takes shape on assembly floor (above); wing root section contains forward fuel tanks and outboard bay carries barrel of 30 mm. cannon. Final assembly (below) shows structural details. At right background are Saab Lanson all-weather fighters.

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AIRCRAFT assigned to the Intrepid include Grumman F11F, Douglas A4D and F4D and propeller-driven Douglas AD attack planes.

Il-28, Tu-16 Threaten Sixth Fleet Area

By Cecil Brownlow

With the U.S. Sixth Fleet—Soviet Il-28 Beagle and Tu-16 Badger medium bombers equipped with 50-mi.-range air-to-surface missiles represent the principal Russian threat to U.S. Navy forces in the Mediterranean.

In the event of war, the task of destroying the two attack carriers which represent the Sixth Fleet's total offensive arm has been assigned to the land-based naval air arm of the Soviet Black Sea Fleet whose force of Il-28s and Tu-16s could effectively sweep most of the Mediterranean area. The Beagle's combat radius is estimated at slightly over 700 mi., the Badger's at 1,500 mi., and the nearest Soviet Black Sea point is approximately 500 mi. from the eastern Mediterranean.

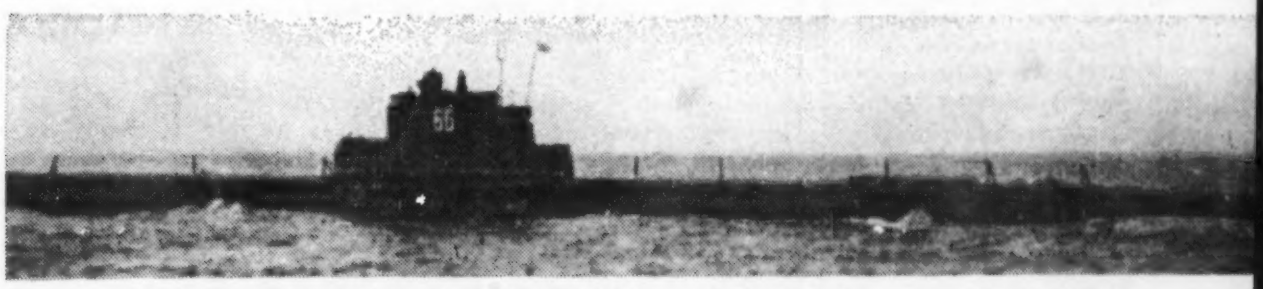
Total strength of the force varies, but the Soviet naval air arm as a whole is estimated at between 2,500 and 3,000 combat aircraft, the majority of them medium-range bombers. Aside from the Black Sea, other navy air units are located on the coasts of northern Russia and Asia.

Nuclear Warheads

The 50-mi. air-to-surface missile with which these forces are now being equipped is believed to be based largely upon the German Comet technique developed during World War II (AW July 13, p. 109). The missiles probably carry nuclear warheads.

For the moment, at least, Vice Adm. Clarence E. Ekstrom, Sixth Fleet commander, discounts the threat of longer-range Soviet ballistic missiles to his units at sea. Greatest safety factor here, Adm. Ekstrom believes, lies in the difficulty the Soviets would have in separating and positively identifying the combat ships without visual observation. With between 750 and 1,000 merchant ships in the area at any given time, long-range radar identification is virtually impossible.

To meet the Il-28 and Tu-16 threat, the initial mission of Sixth Fleet planes would be to destroy the Soviet Black Sea air strength—on the ground, if possible—while operating from their carriers which would be pulled back to



AT LEAST four Soviet-manned W-class long-range submarines (above) are known to be in the Mediterranean, operating from Albania.

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MISSILE DIVISION
North American Aviation, Inc.

Dassault Mirage 3 Radome Nose

First photo of Mirage 3-05 preproduction airplane shows new Cyrano radar unit installed in nose section; final two of 10 preproduction planes are fitted with the radome. Production rate of nine planes per month is expected to be reached by mid-1961. Dassault has firm orders for 100 aircraft. First production model will roll out in September, 1960.

relative safety approximately 1,000 mi. from the Soviet Union.

Once this had been accomplished, the carriers would move to within 150-500 mi. of the Russian homeland to concentrate on the home ports of Soviet submarines, which represent the second greatest menace to the fleet's security, according to intelligence estimates.

At the moment, four Soviet-manned-long-range snorkeling W-class submarines are known to be in the Mediterranean area operating from, and sticking close to, the Albanian seaport of Vlone. (Another eight Soviet-built submarines also are nearby, but they presumably are manned by the Egyptian navy. Eight of them are of the long-range W-class; the ninth is an M-class coastal submarine.)

In addition, the Soviets' land-locked Black Sea Fleet, whose total strength is larger than that of the Sixth, has a force of approximately 90 submarines, at least half of them long-range killer ships that would try and break through the Dardanelles in the event of war and spread out into the Mediterranean in search of the Sixth Fleet.

Soviet Assault Power

For the breakthrough, the Soviets could muster a comfortable air superiority, and the Black Sea Fleet could provide the firepower of an ageing battleship, seven more modern cruisers and approximately 25 ships of the destroyer class. The Black Sea Fleet, with headquarters in Sevastopol, also has an amphibious capability for direct ground assault against the Dardanelles.

The concentration of large Soviet naval strength within the small confines of the Black Sea also probably represents an effort by the Soviets to provide defense in depth against a possible amphibious attack on the Russian industrial triangle that lies along or near its shores.

"We forget sometimes," Adm. Charles R. Brown, commander of Allied Forces-Southern Europe, says, "that the Russians themselves can be scared, too."

Wide Dispersal

If the Black Sea Fleet of long-range submarines should succeed in breaking through the Dardanelles, or if portions of the Baltic Fleet's 150 submarines or the Northern Fleet's 110 submarines should be diverted to the Mediterranean, Adm. Ekstrom believes the Sixth Fleet would be capable of "operating in areas of considerable submarine density . . . with a good opportunity of surviving." This, he says, would be accomplished by a wide dispersal of ships of the fleet and by holding the submarines beneath the surface and inactive by constant air surveillance.

He admits, however, that one of his greatest needs is an anti-submarine warfare hunter-killer task force that would be assigned to the Sixth Fleet on a permanent basis.

At present, the Sixth has an ASW task force assigned to it on temporary duty for about one fourth of each year.

For the remainder of the time, it must rely upon its own limited anti-submarine capability and upon two shore-based squadrons of Lockheed P2Vs that have the primary task of providing the Sixth with ASW coverage.

Main reasons behind the lack of a permanent ASW task group are the usual budget limitations and the overall scarcity of Navy seaborne and air units specifically trained and equipped for anti-submarine warfare.

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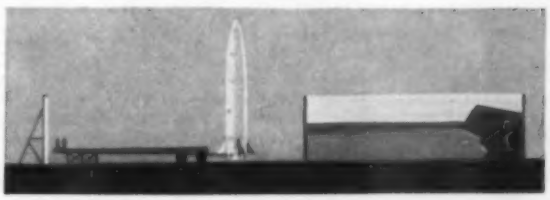
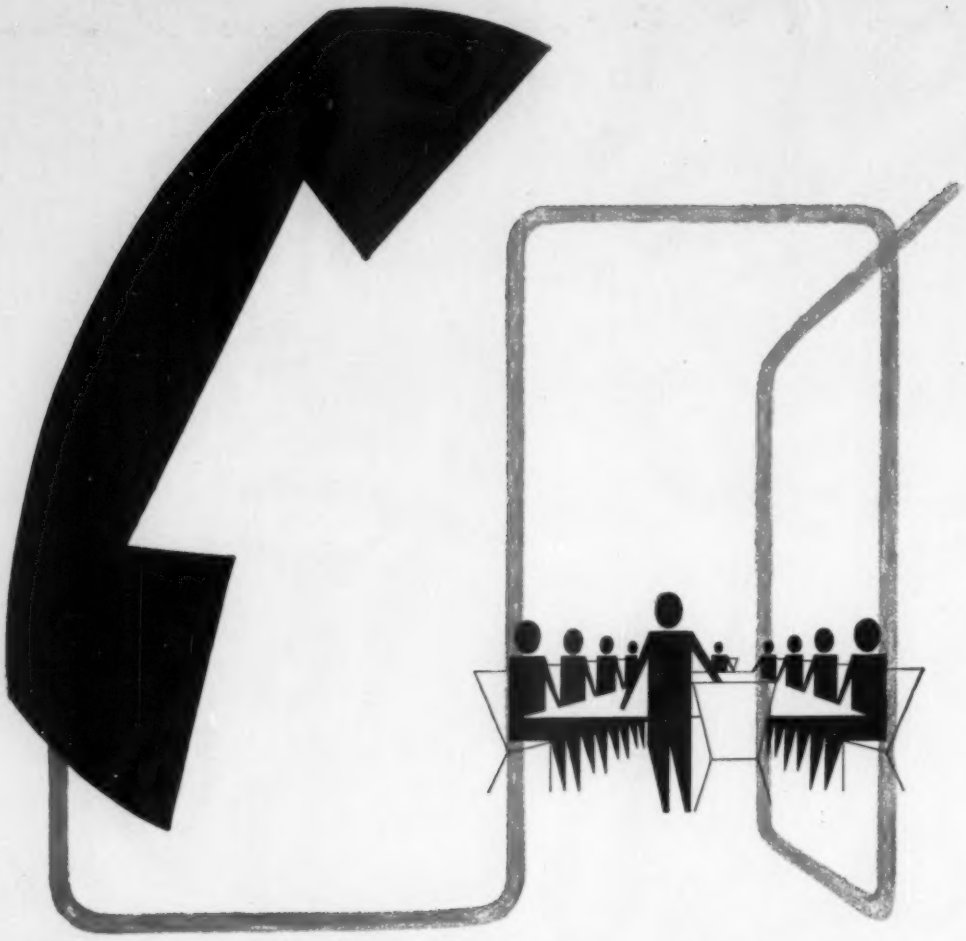


Typical THOR installation, showing a breakaway view of the drive unit in the retractable shelter, missile, free standing end wall of shelter and missile erector.



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threats had been effectively dealt with, the air strength of the Sixth would then turn its main effort toward striking tactical targets in the Soviet Union and satellite complex and to supporting NATO units in any ground battle for southern Europe.

In addition to its tactical role, the Sixth Fleet attack aircraft—five squadrons of Douglas A3Ds and A4Ds—have been assigned secondary "back-up" strategic targets that they would hit on NATO order in the event U. S. Air Force's Strategic Air Command bombers failed to reach them because of routine operational or combat difficulties. Its pilots receive twice-a-day briefings on the weather conditions in the satellite nations and in the Soviet Union.

Creeping Obsolescence

On a day-to-day basis, creeping obsolescence of its surface ships represents the main battle confronting the fleet as a whole. As an example, the keel for the Intrepid, one of two carriers now on duty here, was laid in 1941, and the ship was commissioned in 1943. The ship was torpedoed at Truk, hit by Kamikazies at Okinawa, mothballed after the war and then brought back to life in 1954.

To provide the ship with a jury-rigged capability of handling high-performance jet aircraft, the Intrepid was converted to an angled deck, equipped with steam catapults and a mirror landing system, and fitted with fuel blisters along the side of the ship that permits it to carry an additional 750,000 lb. of aviation fuel.

Despite this, the Intrepid still cannot handle a fully loaded A3D and will be incapable of accommodating the approaching generation of attack and fighter aircraft, such as the North American A3J and the McDonnell F4H.

The Intrepid's engineering officer also estimates that, because of its age and operational requirements that permit little or no preventive maintenance, 60% of the ship's below-deck machinery should be replaced or renewed.

Sud to Convert T-28As to Fighters

Sud Aviation of France will convert 200 surplus North American T-28A trainers to Nomad configuration (AW Nov. 24, 1958, p. 109) under a sublicensing agreement with North American Aviation, Inc.

The aircraft will be equipped with bomb racks, guns and other armament for use by the French air force as strike reconnaissance aircraft. A T-28A modified by North American's Columbus Division is undergoing desert tests in Algeria.

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CUT YOUR MANHOURS 40%

Up to 40% savings in manhours can be realized by using Blind Nuts requiring only one installation step compared to conventional nutplates or gang channel nuts, each requiring four installation steps.

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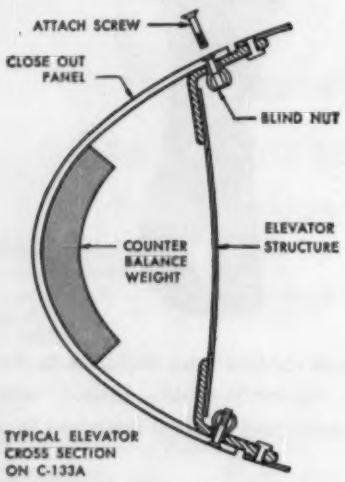
Because its expander nut is drawn and locked into the sleeve, use of the Blind Nut also eliminates possible rework time during the installation of access or close-out panels when an entire gang channel must be replaced if a nut is knocked out.

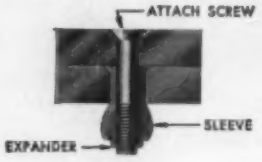


TYPICAL ELEVATOR CROSS SECTION ON C-133A

Stainless steel Blind Nuts are quietly installed at about ten per minute by one man using a lightweight hydraulically operated gun. Hand installation tools are also available. Blind Nuts will accommodate screw or bolts in sizes ranging from 4-40 to 3/8-24.

BLIND NUT INSTALLATION STEP.—

1. Insert sleeve and expander nut through hole and operate gun.



TYPICAL BLIND NUT INSTALLATION

GANG CHANNEL NUT INSTALLATION STEPS

1. Temporarily screw gang channel in place.
2. Drill and countersink rivet attach holes through work and channel.
3. Install attach rivets.
4. Remove temporary screws.

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AMC Contracts

Wright-Patterson AFB, Ohio—Following is a list of unclassified contracts for $25,000 and over as released by the Air Materiel Command:

AiResearch Division, The Garrett Corp., Los Angeles, Calif., 3 ea., air conditioners A/E32C, spare parts, drawings and data for ground support on the 314L/313L system, (PR EM-9-RD-6245), $96,398.

Kollsman Instrument Corp., Elmhurst, N. Y., components of MD-1 automatic astro compass system (applicable to B-52 aircraft), (PR EG-9-05A-4715), $3,740,000.

Republic Aviation Corp., Farmingdale, N. Y., F-105D aircraft and support items, (PR TF-9-1510-7370), $4,500,000.

Bell Helicopter Corp., Ft. Worth, Tex., development, redesign and modification of XH-40 helicopter, (PR-47917), $500,000.

Red Bank Division, Bendix Aviation Corp., Eatontown, N. J., 18 ea., regulators, voltage, a.c., Aerno 42-6061 and 12 ea., generators, 2-kva, a.c., three phase, Aerno 42-6053 for F-100D and F-104D aircraft (PR EA-9-03C-4901), $33,641.

Small Aircraft Engine Department, General Electric Co., West Lynn, Mass., 74 ea., T58-GE-6 turboshaft engines, gearbox assemblies, data and bill of materials for HSS-2 and HU2K-1 and aircraft (Navy), (MIPR R59-1923-19-NOas), $2 million.

Sperry Gyroscope Co. Division, Sperry Rand Corp., Great Neck, N. Y., microwave command guidance system operation and support, (PR DQ-5895B-7332), $361,416.

The Firewel Co., Inc., Buffalo, N. Y., closed circuit respiratory systems, (PR's EM-9-RD-6274 and EM-9-RD-09569), $71,-362.

Bill Jack Scientific Instrument Co., Salona Beach, Calif., 68 ea., 6760-512-7597 power supply, metallic type, full wave rectification; 83 ea., 6720-213-9226 (8400-175500) P/N 12735 contact set, circuit breaker, and maintenance data (USSC spare parts items) for unknown aircraft, (PR's MO-9-6760-1118 and MO-9-6760-2200), $32,503.

Small Aircraft Engine Department, General Electric Co., West Lynn, Mass., 31 ea., J85-GE-3 turbojet engines, (PR PE-9-2840-4157), $3,392,025.

Sperry Phoenix Co. Division, Sperry Rand Corp., Phoenix, Ariz., guidance data transponder set, type AN/APW-22 (XY-1) used in the Q-2 and the Q-4 drone, (PR EG-9-5895-4598), $192,000.

Department of Aeronautical Engineering, Instrumentation Laboratory, Massachusetts Institute of Technology, Cambridge, Mass., study, design, fabrication and test of advanced inertial navigation system, (PR EG-9-1280-4374), $810,000.

CBS-Hytron Division, Columbia Broadcasting System, Danvers, Mass., 2 ea., CBS-Hytron cathode ray tubes, drawings and data, end use is unknown, (PR EC-9-RD-4385), $49,424.

The Goodyear Tire and Rubber Co., Akron, Ohio, 353 ea., wheel assemblies, main, 20.00-20, type III, Aerno. 41-1178 (spares for C-130B aircraft), (PR 00-9-03B-2800), $166,301.

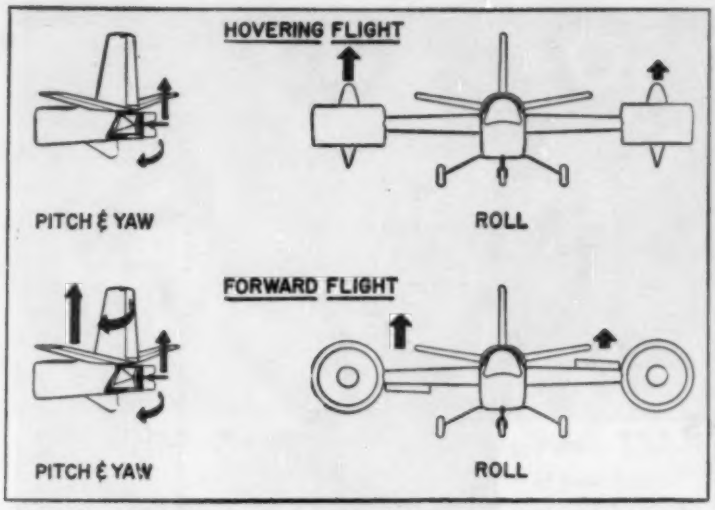
Crosley Division, Avco Manufacturing Corp., Cincinnati, Ohio, 33 ea., 1270-518-4623 interconnecting box, P/N 7330111G2, applicable to MD-4, MIDA fire control system used on B-47 and B-66 aircraft, (PR WR-9-1270-1000), $172,758.

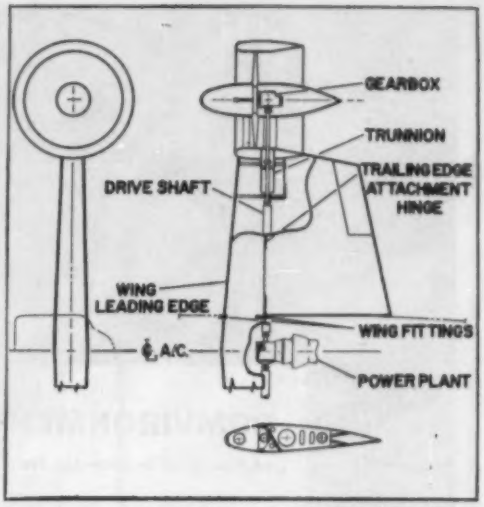
Mechanics Research Department, American Machine and Foundry Co., Chicago, Ill., control system and components for MB-1 absorber, (PR EM-9-RD-6252), $188,086.

HRB-Singer, Inc., State College, Pa., 6 ea., test tower facility, model TTF-1, (PR 913214-A), $51,008.

Organic Chemicals Division, Monsanto Chemical Co., St. Louis, Mo., 6,000 lb. of lubricant, M-Bis (M-Phenoxyphenoxy) benzene, (PR EM-9-RD-6324), $116,000.

John B. Hollingsworth Co., Phoenixville, Pa., 5,372 ea., mountings, MT-1151/APX-25, Aerno. 81-4404, end use is in B-52, B-47, KC-97 and F-86 aircraft retrofit, (PR MD-9-16K1-55150 and amendments 1, 2 and 3), $48,348.





CONTROL VECTORS are shown at left for both hovering and forward flight. Pilot control movements are the same for both flight regimes. Diagram at right shows the duct fan arrangement. Flexible couplings are used to correct shaft misalignment or wing flexure.

Doak 16 Demonstrates Design Feasibility

Los Angeles—Low vibration level, greater airframe-to-payload weight ratio coupled with the advantages of a conventional control system are features which make a ducted fan vertical takeoff and landing aircraft attractive, according to engineers of the Doak Aircraft Co.

Feasibility of a ducted fan VTOL is no longer a matter for speculation, according to B. J. Uberti and J. B. Reichert of the Doak company. The Doak model 16, powered by an 840 eshp. Lycoming T53-L-1, has made conversions from vertical to horizontal flight and test pilot Reichert has also made successful conversions from horizontal to hovering flight at pressure altitudes from 3,000 to 6,000 ft.

Tests were conducted at Edwards AFB, Calif., where field elevation is 2,302 ft. (AW June 8, p. 34).

Hybrid Design

Design of the Doak 16, Army designation VZ-4DA, is actually a hybrid wherein the major emphasis was placed on design, engineering and construction of the wing tip ducts, fans, hovering stability parameters, and the power transmission system and pilot controls. Parts of existing aircraft were used where practicable, such as a Cessna 182 landing gear, seats from an F-51, rudder mechanism from an early Doak aircraft, duct actuators from T-33 flap motors, and "several other off-the-shelf mechanisms."

The more or less conventional components of the aircraft, such as forward flight controls, fuselage truss and equipment installations, were conservatively and quickly designed. However, those unconventional aspects, such as the wing, duct, fan blades and hub and hovering controls received the major emphasis because of their safety-of-flight aspect.

Originally, Army specifications called for the fuselage of the aircraft to remain uncovered, but this specification was rewritten when it was decided that the value of forward flight data would more than offset the added weight penalty, the engineers told the Institute of the Aeronautical Sciences meeting here.

Lycoming T53-L-1 turbine is buried in the aircraft fuselage and operates as a free turbine, turning a gearbox which reduces engine speed from 6,700 rpm. to turn transmission shafts at 4,800 rpm. Shafts travel through the wing quarter chord point and couple into transmissions in the hub of each wing tip duct. Doak-designed flexible couplings are used to correct for shaft misalignment or wing flexure.

Each of the two ducted fan units houses eight plastic fixed-pitch blades with 14 inlet guide vanes upstream of the blades and nine straightening stators downstream. Cruciform-type vanes for pitch and yaw control are located in the exhaust efflux at the rear of the aircraft.

Control in forward flight is achieved conventionally by stick and rudder pedals actuating conventional elevators, ailerons and rudder. Uniquely, stability in hovering and/or vertical flight is achieved through the same control motions. Stability in yaw and pitch is achieved through deflections of the cruciform vanes in the jet efflux by rudder pedal action or fore and aft stick motions. Lateral stability is achieved by sideward motion of the stick, which controls the pitch of the 14 inlet guide vanes. As the ducts are rotated from vertical to horizontal, a mechanical fadeout system gradually reduces inlet guide vane pitch changes to zero.

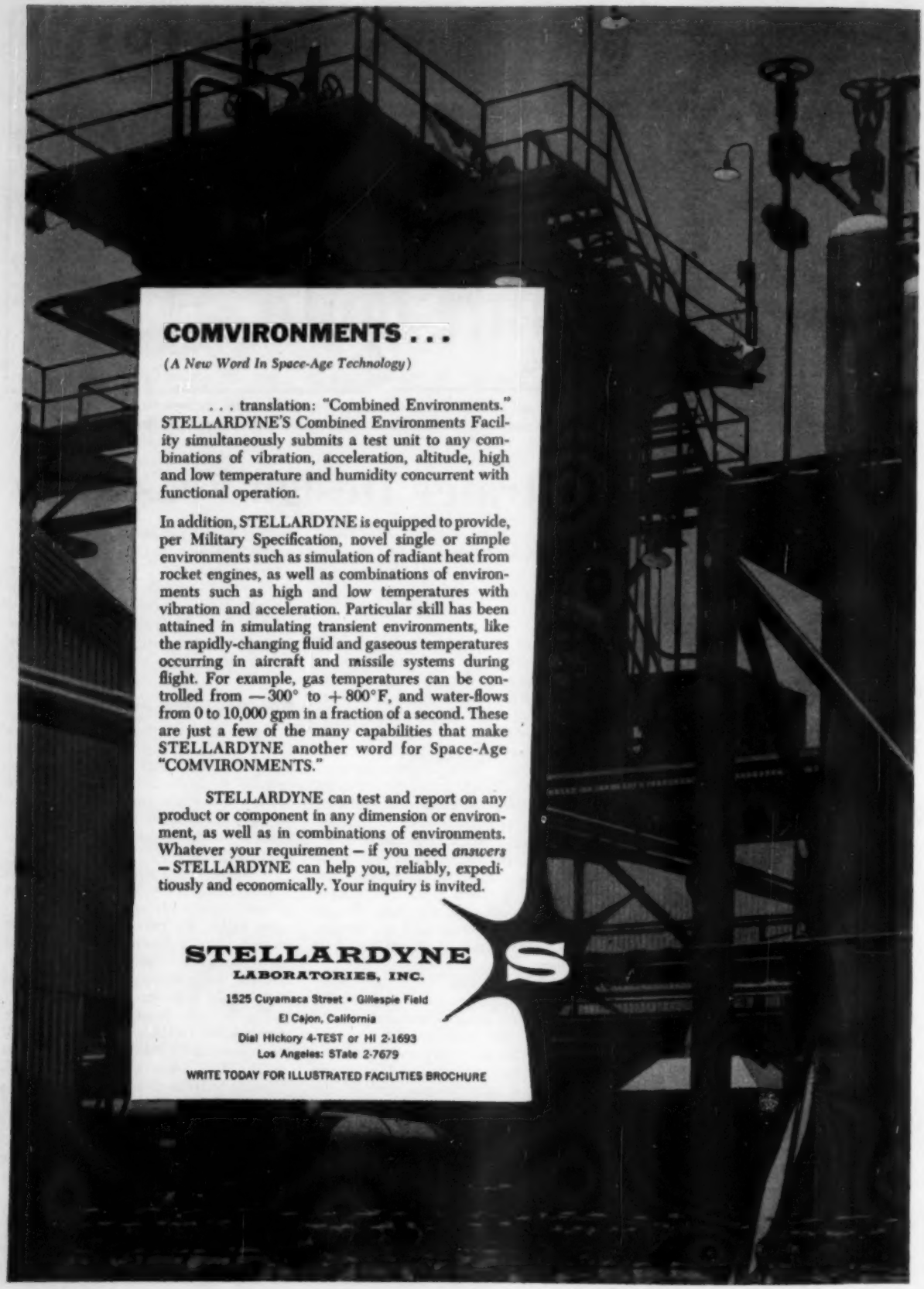
Unconventional Aspects

Unconventional aspects of the Doak control system consist of a vernier throttle control and a switch on the control stick to actuate the electric motors that rotate the ducts. Duct rotation switch is thumb-operated in a manner similar to trim tab controls on a jet fighter.

Wing tip ducts can be rotated from a horizontal plane for forward flight to two degrees aft of vertical for hovering flight. By rotating the ducts aft of vertical, a sufficient rearward thrust component is available to compensate for the residual thrust of the turbine engine exhaust.

Flight test program, which commenced last October at Edwards AFB, was preceded by 50 hr. of ground tests at the Doak plant in Torrance, Calif. Ground tests involved 32 hr. spent on a four-component test stand and 18 hr. of tethered hovering, free hovering, and taxi tests. Test stand results reveal a pitching acceleration of approximately 1.7 radians/sec./sec., yawing acceleration of .34 radians/sec./sec., and rolling acceleration of 1.7 radians/sec./sec.

Tethered hovering provided the opportunity for development of pilot



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Ryan, General Electric Study Vertifan Concept

Ryan Aeronautical Co. has started a preliminary design study of Ryan Vertifan concept of VTOL and high speed forward flight aircraft under a U. S. Air Force contract; General Electric Co. will work with Ryan on the study. Vertifan features fans submerged in the wing and powered by a tip turbine, driven by jet engine exhaust, to provide VTOL and hovering lift. In forward flight, power is diverted from fans to straight thrust. Exhaust is diverted to fan turbine by scrolls; movable vanes deflect mass flow from the fans.

technique and briefly explored hovering characteristics.

Flight program started with approximately 15 hr. of development tests, followed by a second group of tests to research the aircraft's performance, stability and control. Research flights of approximately 35 hr. have been observed by an Air Force Vertol H-21 helicopter.

Forward Flight

Forward flight investigation, which, according to Doak, may see speeds in excess of 200 mph., will be chased by an Air Force Cessna T-37 twin-jet trainer.

Aside from strictly VTOL investigations, short takeoff and landing (STOL) capability is also being investigated. According to Doak, very short landing rolls have been achieved by rotating the ducts past the vertical and utilizing the rearward thrust component to shorten the roll.

Lockheed to Maintain Navy WV-2s, R7Vs

Lockheed Aircraft Service, Inc. will maintain Navy Lockheed WV-2 and R7V aircraft at New York International Airport and at Honolulu under two contracts totaling $13,100,000. The New York contract covers the Atlantic WV-2 aircraft based at Argentia, Newfoundland, and Patuxent River, Md. The Honolulu contract calls for maintenance work on Pacific based WV-2 airborne early warning aircraft and R7V transports and will be performed at the Navy facility in Keehi Lagoon, Hawaii.

Lockheed Aircraft also has received a $2 million letter contract from USAF authorizing development of four F-104 drone aircraft to fly as unmanned targets for missiles.

Designated QF-104, the drone will be employed as a remotely-controlled recoverable target.

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Missile Range Assists Lightplane Pilots

By Russell Hawkes

Pt. Mugu, Calif.—Pacific Missile Range has offered business and private pilots radar surveillance, weather advisories and traffic control services to combat the hazardous situation which occurs along the missile coast here when marginal weather and nearby mountains squeeze non-instrument aircraft into a channel along the Pt. Arguello beach.

The offer was extended at a fly-in luncheon-briefing which attracted 120 civilian pilots in 44 planes from all over southern California. Another invitational fly-in will be staged by the range in November.

Veteran pilots told AVIATION WEEK they could remember no instance of such thorough consideration from a military service. Many said the Pacific Missile Range idea should be adopted by other military commands which administer Restricted and Warning Areas that blanket much of the area of the Southwest.

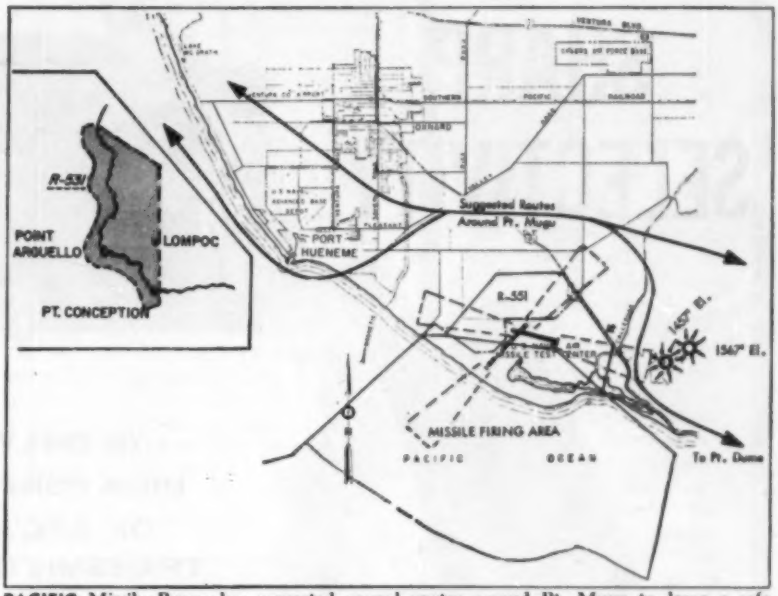
The range opens its reserved airspace to civilian aircraft as frequently as possible and will now provide services which are normally provided by FAA in unreserved airspace.

Restricted Area R-531, around Vandenberg AFB and Naval Missile Facility, Pt. Arguello, is the Achilles heel of present arrangements since there is no satisfactory way to communicate with civilian aircraft in flight. Efforts to set up cooperative procedures are hampered by the status of the base as a maximum security area which extends out to the three-mile limit of international law.

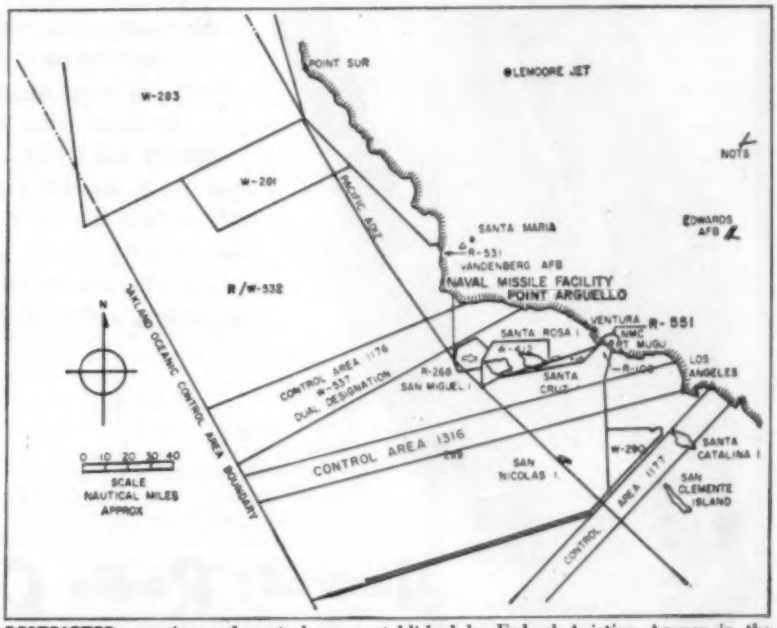
As yet unapproved is a plan to establish an ARSR-1 surveillance radar on Tranquillon Peak in the southern part of the Pt. Arguello reservation with a transceiver operating on the civilian tower frequency, 122.5 mc., to issue advisories and instructions to private traffic going around the point.

At 2,170 ft., Tranquillon is the highest point in the area and could give radar and VHF coverage to all the coastline bordering the Naval missile facility and the adjoining Air Force base. Installation would be operated by PMR range control whose call sign is Erskine. The plan is now undergoing architectural and engineering evaluation at headquarters, 11th Naval District in San Diego.

Until the Tranquillon plan goes into



PACIFIC Missile Range has suggested several routes around Pt. Mugu to leave a safe passage for light planes between Navy traffic and bordering mountains. Safe routes are just northeast of U. S. 101 Alternate until past the Naval Air Station and well south of Oxnard AFB. Civilian flights can pass directly over the station above 3,000 ft.



RESTRICTED, warning and control areas established by Federal Aviation Agency in the Pt. Arguello area are detailed above. Pacific Missile Range gives Los Angeles Air Route Traffic Control Center 30 min. notice when the warning areas must revert to restricted status, usually prior to missile firings.

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effect, it will be necessary for light planes to telephone for instructions or fly around the mountainous inland boundary of R-531. An interim plan is being discussed to relay requests and instructions from Erskine through Vandenberg Air Force Tower on 122.5 mc. This has already been done on several occasions. If private aircraft can transmit and receive on military frequencies, they can contact Erskine directly on 5,080 kc., 143.28 mc. or 253 mc., but Pacific Missile Range discourages this as a regular practice for fear it will block frequencies and overload personnel when they are most needed.

With permission, it is possible to fly along the seaward edge of the Restricted Area until 30 min. before launch of a missile or satellite from Vandenberg AFB or Pt. Arguello. Permission will not be granted after that until the launch pads are secured. When technical holds, etc., after T-30 delay the shot, the delay must be imposed on beach-flying lightplane pilots, too. Permission must come from PMR Range Scheduling at Oxnard, Calif., HUnter 6-1681, Ext. 358 or from Erskine.

Naval Air Station Pt. Mugu reports unusually frequent near midair collisions between light aircraft and Pt. Mugu-based jets which include the supersonic Chance Vought F8U and occasionally the Mach 2 MacDonnell F4H. Traffic speeds are often about 270 kt. Lightplanes have penetrated the traffic pattern without warning at speeds as low as 80 mph.

Private pilots like to fly along main highways and beaches. Pt. Mugu is located on both. Most try to stay well clear of the air station and its Restricted Area R-551, but there are the inevitable 2% who fly straight over it without realizing it is there. This is partly due to the fact that coastal regions are plagued with low stratus in the morning and Mugu is usually one of the last places to clear.

A few lightplane pilots have carefully followed the practice of flying out over the water to avoid Naval Air Station traffic.

This places them in Restricted Area R-100, also known as Missile Test Area "A."

Cdr. James M. Johnson, PMR Range Operations Officer, delivered the briefing to private and executive pilots at the fly-in. He acknowledged the need of non-instrument business aircraft to operate along the beach. Six months previously, he had told AVIATION WEEK that he hoped to persuade business flyers to make their marginal VFR, coastal flights through mountain passes inland. Later, he flew through the mountains a few times himself in a light twin-engine aircraft to check the feasibility of the idea. At the fly-in, he advised guests

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Germans Building Six-Seater

Featuring a ducted pusher propeller with shaft permitting carry-through of tail boom structure, six-place RF-1 private plane is near completion at Rhein-Flugzeugbau's Krefeld, German, plant. Model shows basic configuration, which incorporates two 250-hp. Lycoming engines coupled to the single shrouded propeller. Wing span is 43.9 ft., leagth 42.9 ft. and height 12.6 ft. Estimated performance: takeoff distance, 361 ft.; takeoff distance over 49.2-ft. obstacle, 508 ft.; maximum rate of climb, 206 fpm. and range with auxiliary fuel tanks, 931.5 mi. Company's previous design is the novel RW-3 Multoplane, which features a pusher propeller mounted in slot in tailplane.

against it. "I wouldn't do it myself, so we surely can't ask it of you," he said.

Johnson described rules to ensure good separation between coast-flying lightplanes and military traffic at Pt. Mugu. A ceiling of 3,000 ft. has been placed over military aircraft departing and arriving at the Naval air station. Civil aircraft can overfly the station safely above that altitude without clearance. When low ceiling forces civilian traffic below 3,000 ft., Navy Mugu Tower will clear it straight through the traffic pattern on request as soon as safe separation from military aircraft allows. To make this convenient, Navy Mugu Tower will operate on civilian frequencies 118.5 mc. and 122.5 mc. as well as Guard Channel 121.5 mc.

To allow passage of no-radio aircraft, boundaries of the Mugu Restricted Area, R-551 have been gerrymandered to run along U. S. Route 101 Alternate, leaving a half mile margin between the highway and the mountains. There will be good separation if civilian aircraft stay above 1,500 ft. and northeast of the highway. Approach zones to Runway 27 and Runway 21 at Mugu overlay the highway in places, but heavy aircraft will cross it at very low altitudes. Chase planes also cross the highway from the north at about 500 kt. to pick up Chance Vought Regulus missiles being launched from pads along the beach, but the crossing is made at under 500 ft.

Pacific Missile Range has chosen a policy of unusually close cooperation with civilian aviation interests, including joint use of PMR's reserved airspace and reciprocal assistance agreements with nearby FAA facilities. According to Pacific Missile Range policy, representatives of civilian airspace users are brought in for conferences before approaching FAA to ask for new reserved airspace. The purpose is to make as many compromises as possible to accommodate the needs of other users and keep their good will. After reserved airspace is established, civilian representatives are brought in again to work out cooperative procedures for its use and to begin publicizing its existence.

Airspace reserved for missile firing is opened to civil users when the day's firing schedule closes. Pt. Mugu has hot-line telephones to Los Angeles Air Route Traffic Control Center to notify pilots that Restricted Area R-100 and Warning Area W-289 are open. Low Frequency Airway Green 4 passes hot-line telephones to Los Angeles Air through the northern end of R-100.

To cooperate with transpacific airlines, a dual-designated corridor extending westward from Santa Barbara across PMR's Sea Test Range was created at the suggestion of the range. An effort is made to build firing schedules around known airline schedules. When firings are scheduled, Los Angeles ARTCC designates the corridor, Warning Area W-537. When word comes over the hot-line that firings are ended, it is opened to traffic as Control Area 1176. A second dual-designated corridor to be called Control Area 1316 has just been created extending along the 251 deg. true radial from Los Angeles VOR across W-289 to eliminate fuel and time consuming doglegs via Santa Barbara or Catalina.

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SPAN of E. G. Haase's HKS 3 glider is 56 ft. 5 in. Over-all length is 23 ft. 7 in. Wing load is 4.5 lb./sq. ft., and gliding ratio is 37 at 53 mph. Sinking speed is 2 fps. at 40 mph. This glider took first place in open class at Germany's 1959 glider competition.

11 Glider Designs Fly in German Contest

By Edith Walford

Karlsruhe-Forchheim, Germany—Eleven different single-seat glider designs, products of Germany's reborn aviation industry, were flown in the 1959 German glider competition held here.

Glider design and gliding, like the German aircraft industry as a whole, have suffered two serious setbacks as a result of both world wars. Twice all activity in the field has had to be suspended for many years. But again, like the rest of the industry, it has somehow managed to keep its talent and enthusiasm alive throughout the first few postwar years.

Rebirth of Gliders

By 1950, the nucleus of Germany's prewar glider designers and pilots were getting together again, pooling their knowledge and facilities and preparing for yet another rebirth of the gliding industry.

By 1955, with a total of 1,273 gliders already built and in use and another 254 under construction, they were well on their way toward regaining their prewar status.

Steady Growth

The growth has continued steadily. Today, gliders in use number 1,726 and there are another 189 under construction.

Takeoffs numbered 426,774 in 1955, 447,900 in 1956, 541,422 in 1957, and 594,967 in 1958, the latest figure available.

Hours flown for the same years respectively were 51,627; 63,306; 82,250 and 97,190.

Total miles flown during the last two years were 33,784 in 1957 and 60,236 in 1958.

Very few of the gliders are privately owned. Most of them belong to Germany's 543 aero clubs and their flying schools which, including the 930 associated smaller local clubs dotted around the country, have a total membership of 40,000.

Open and Standard Class

The 1959 German glider competition consisted of an open class and a standard class.

Contestants in the open class are subject to no limitations, whereas gliders in the standard class cannot have a span exceeding 49½ ft. Their wings cannot be adjustable in flight nor can the gliders have a retractable landing gear. Both classes may have radio installations.

Eight of the 11 different glider designs were flown in the open class, and three of them in the standard class.

Of these, FS 24 Phönix, of strikingly graceful appearance, attracted most attention. Designed and built toward the end of 1957 by H. Nägele and R. Eppler of the Academic Group of Pilots (Akademische Fliegergruppe), a department of the Technical College, Stuttgart, it is the first German glider to be made chiefly of lightweight synthetic materials. Of sandwich construction, the polyester resin, fiber glass reinforced skin covers a balsa-wood frame.

It was entered in the open class of the race.

Other Glider Designs

Other open class gliders in the competition were:

• **HKS 3 flown by first winner,** E. G. Haase, who belongs to the Haase-Kensche-Schmetz Entwicklungsgruppe, Herzogenrath near Aachen.

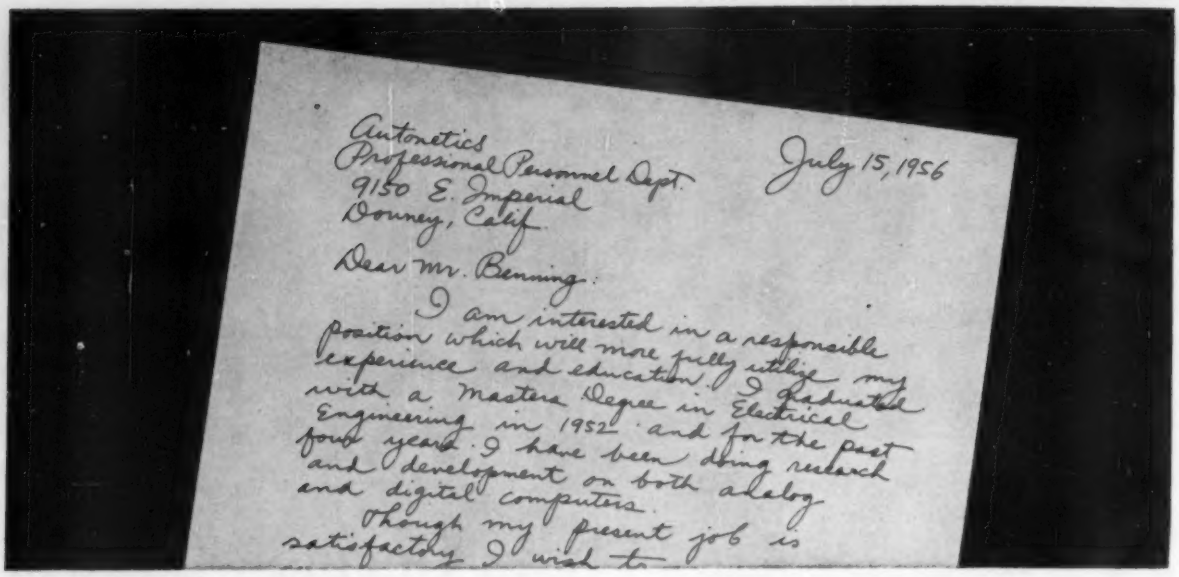
• **Mü 22 flown into second** place by W. Kunz. Designer of the Mü 22 is Dipl.-Ing. Scheibe of Scheibe Flugzeugbau GmbH., Dachau near Munich, one of Germany's pioneer glider designers. Prewar, Scheibe was head of the Flugtechnische Fachgruppe der Technischen Hochschule, Munich, where, among many other types, he developed the Mü 10 Milan two-seater and the Mü 13 gliders. This latter won the Rhön Competition in 1936. At the end of 1951 he founded his own company and began building his first postwar models. First in this series was the two-seater

Competition Scoring

The 33 entries in the 1959 German glider competition represented the elite of Germany's postwar gliders and pilots. Twelve of these entries competed in the open class and 21 in the standard class.

E. G. Haase, with a total of 3,579 points, won the open class championship in his HKS 3 glider. Heinz Huth, with 4,056 points, came first in the standard class in his Ka 6 model.

W. Kunz, one of Germany's strong cards among its crop of new generation glider pilots and much favored to win the world championship title in the open class next year, gained 3,180 points (Mü 22) for second place in the open class; R. Spänig with 3,141 points (Zugvogel III) took third place. Hans Böttcher with 3,850 points (Ka 6) took second place in the standard class and Ulrich Pfarre with 3,425 points (Ka 6) took third place.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Bergfalke, followed by the Spatz—he also produced a powered version of this model—the Specht and Sperling gliders. He designed a total of 275 different types during the years 1951 to 1957. Many of these are now being made under license by other companies in the business.

• **Zugvogel III** flown by R. Spänig into third place in the open class. Designed and built in 1954 by Ing. Rudolf Kaiser of Flugzeugbau Alexander Schleicher, Poppenhausen an der Wasserkuppe, and Dipl.-Ing. Scheibe, the same man who is responsible for the Mü series, Zugvogel III is the latest of this type. It flew for the first time in April, 1957.

• **Geyer II** developed by Allgaier Segelflugzeugbau Josef Allgaier, Nesselwang/Allgäu, is based on its predecessor, Geier I, introduced in 1955.

• **Weihe 50** designed by Hans Jacobs in 1938. Jacobs is considered Germany's most successful glider designer. Weihe 50, among many more recent designs, is now being built under license by Focke-Wulf GmbH., Bremen. Jacobs began his career as a ship engineer, but found his way to the Wasserkuppe in the Rhön, cradle of German gliding in 1927. In 1933 he joined the Deutsche Forschungsanstalt für Segelflug and finally became its head. He has designed gliders since 1931. The Rhönadler, Rhönbussard, Rhönsperber, Kranich Habicht, Weihe, Seeadler and Reiher designs were all conceived by him. Jacobs' last prewar model, the Meise, was chosen shortly before the war as the best standard design of about half a dozen other entries at the First International Construction Competition at Rome.

• **HKS 1** developed jointly by the Haase-Kensche-Schmetz Development Group, Herzogenrath nr. Aachen. A two-seater version of this model was produced in 1952 and flight tested at Düsseldorf on July 9, 1953. Only two prototypes have so far been built.

• **Lo 150** was conspicuous at Karlsruhe-Forchheim because it was the only foreign entry, flown by R. Bocksch of Buenos Aires. Ing. Alfred Vogt, Preissenberg-Ammerhöfe (Oberbavern) is responsible for the design. It is the last in the Lo 100 series developed by the Verband Deutscher Flieger in Czechoslovakia in 1935. Because of the intervening World War II, it could only be flight tested in 1943. The Lo 100 was followed in 1952 by another version of the same glider, the Lo 100 Zwergreiher, on which the Lo 150 is based.

Standard class gliders competing included:

• **Ka 6** flown by Heinz Huth, Hans Böttcher and Ulrich Pfarre into first, second and third places respectively in this class was designed by Ing. Rudolf Kaiser of Poppenhausen an der Wasser-

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- ☐ R-F CIRCUITS
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kuppe. The Ka series of gliders, named after their designer, was started in 1950. The first model, Ka 1, was flight tested at Easter 1952 at the Wasserkuppe.

• **Ka 8** also flown at Karlsruhe-Forchheim, is a simplified version of Ka 6. It has a steel tube fuselage, whereas Ka 6 has one made of plywood.

• **L-Spatz 55** developed by Dipl.-Ing. Scheibe of Dachau nr. Munich. This model won the championship at the Rhön Competition 1957, setting up a new German long distance record of 549 mi.

79-mi. Race

In an out-and-return race held from the airfield at Karlsruhe-Forchheim to Offenburg and back, a distance of about 79 mi., 31 participants were launched in succession by two Dornier Do-27s, three Super Piper Cubs, two Tiger Moths, one Auster and one Klemm 107B.

The first glider to complete the course was followed at intervals of five to 10 min. by about half a dozen others and finally by as much as an hour or two by the last returning gliders.

Even before final results were broadcast, it was a foregone conclusion that E. G. Haase and Heinz Huth, two glider pilot aces, would be among the winners. Haase is holder of the open class world championship title won last year at Lescno, Poland, among a total of 62 entries from 22 different countries. Huth came third in the standard class of the same international competition.

Up to now the international contest has been held every two years in different European countries. It will be Germany's turn next year, although which of the 446 airfields scattered around the country to be chosen for the event has not yet been decided. After 1960, it will be held every three instead of every two years.

Okanagan Studies Passenger Service

Vancouver, B. C.—Okanagan Helicopters, Ltd., has set up a subsidiary, Copter Cabs, Ltd., to develop an executive travel service between Canadian airports and major industrial plants, using Omega BS-12D helicopters.

Company has ordered three BS-12Ds from Omega Aircraft Corp., Bedford, Mass., each powered by two 310 hp. Lycoming piston engines (AW July 27, p. 41). Aircraft can be equipped with floats for overwater flight.

Glenn W. McPherson, Okanagan president, said passenger service has been delayed due to Department of Transport restrictions on flying over built-up areas. Omega's twin-engine performance, he said, should permit such flights.

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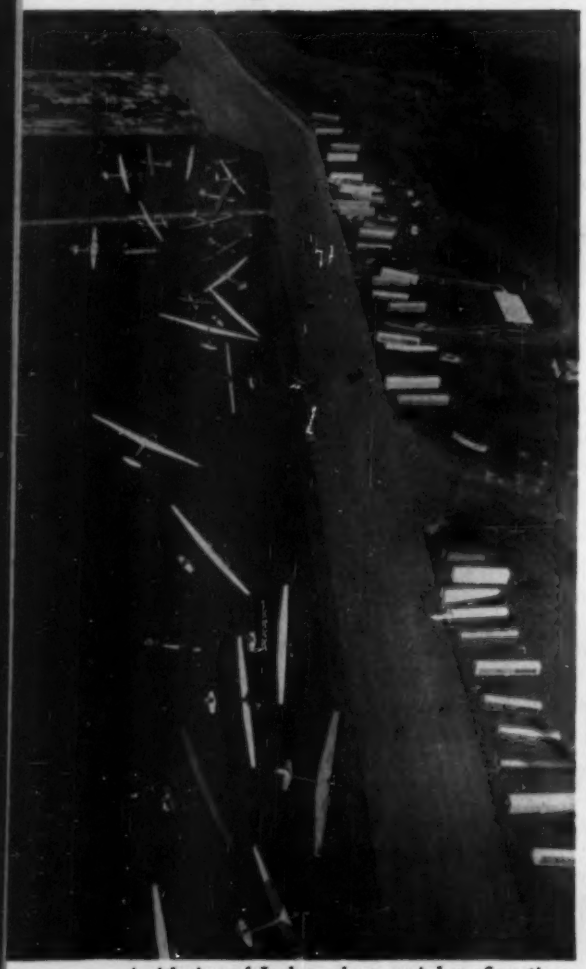
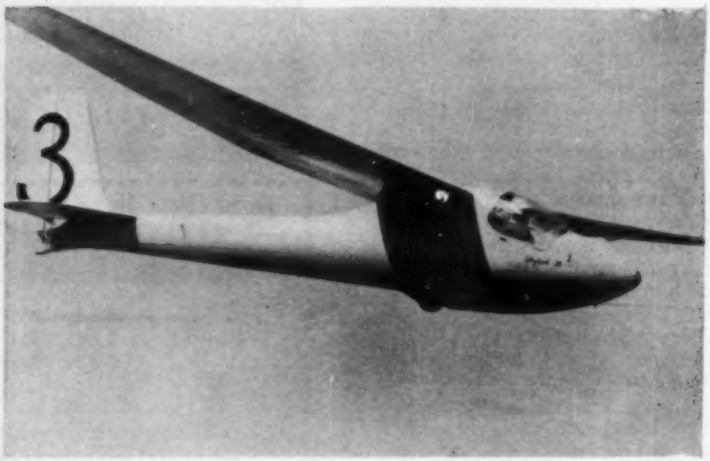
British T-42B Eagle glider lands during a run at the British National Gliding Championship meeting at Lasham, Hampshire, England. About 80 gliders from several nations participated. First place was won by Geoffrey Stephenson, London, in a Skylark 3.

Foreign Gliders Among Entries in British Meet

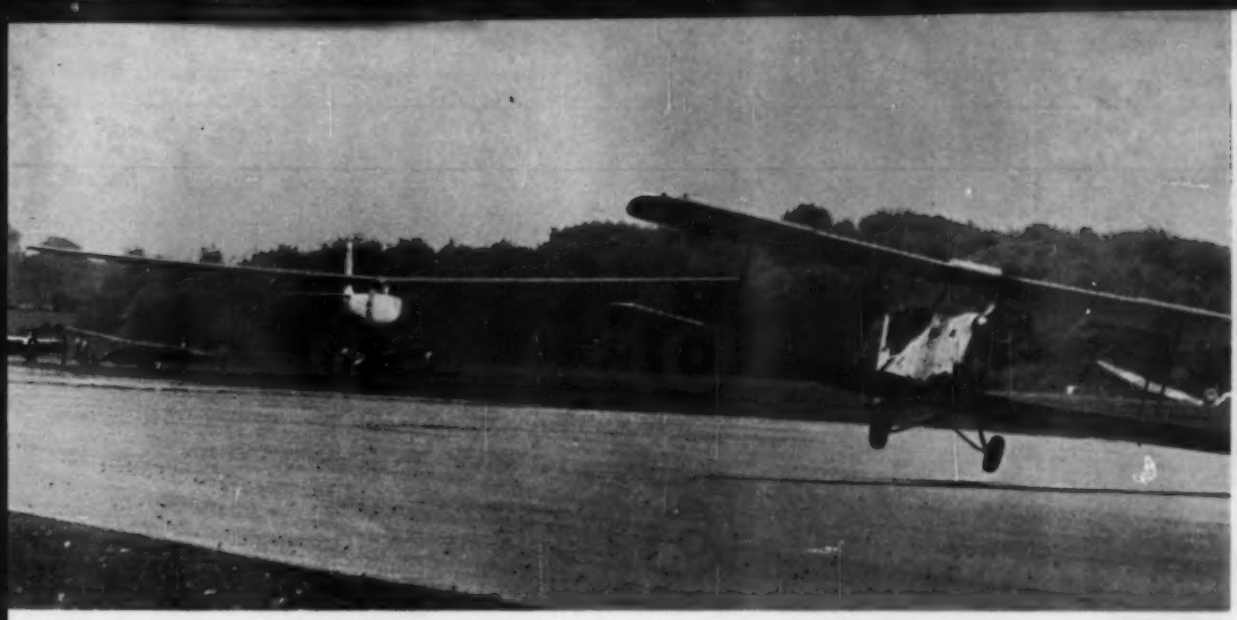


Aerial view of Lasham shows varied configurations of glider entries.

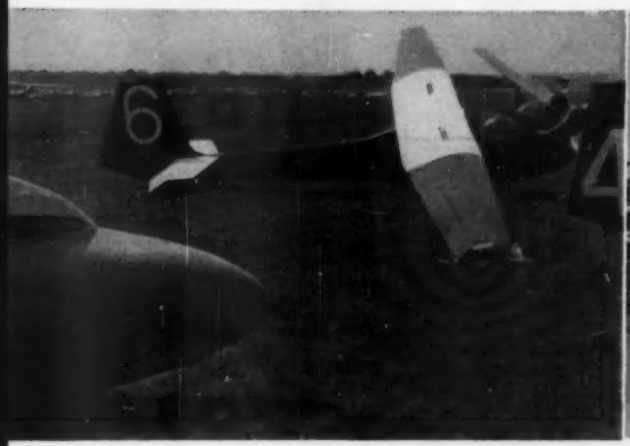


Skylark 3B is launched by Tiger Moth at Lasham; note launch cable attached to the nose section.

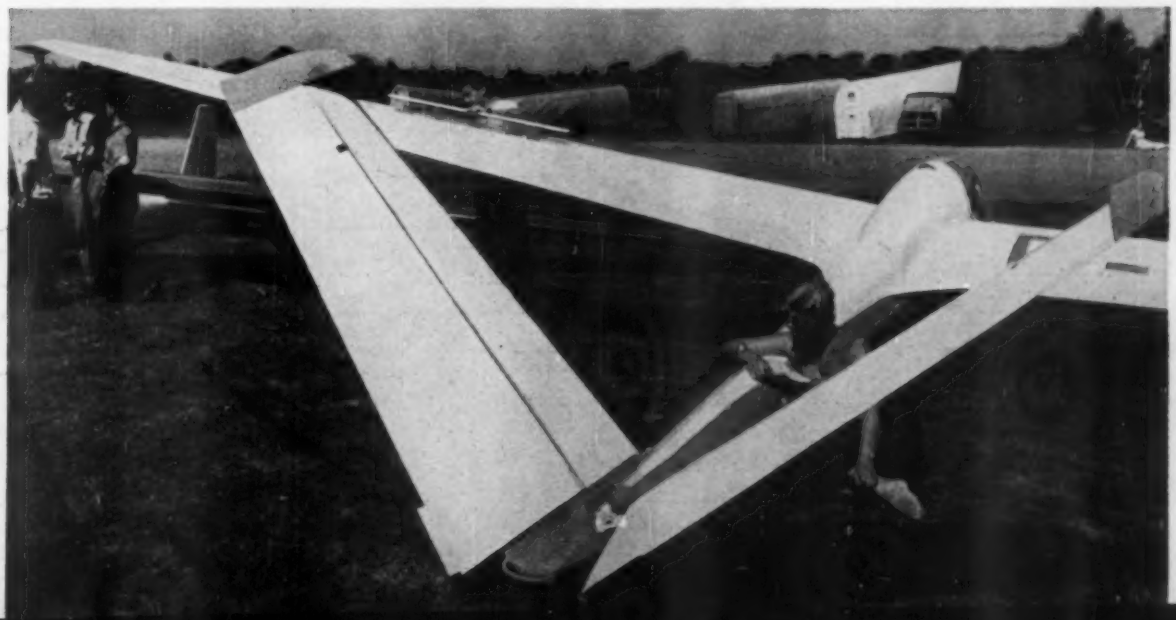
Crew rigs British Olympia entry. Note spoilers in up position and glider trailers in background.



All launches at Lasham were made by Tiger Moth aircraft, shown above towing a Skylark 2 off the runway. Skylark 2, with a 59 ft. wingspan, is a larger version of Slingsby Skylark, a standard type with laminar flow wing. In one run, Skylark 2 flew 50 mi.



British Skylark 3 (left), piloted by Cmdr. Nicholas Goodhart, won interservice championship and placed second for over-all gliding championship with 475 points of a possible 600. At right is a Polish Jaskolka, which has a 52 ft. wingspan, maximum weight of 595 lb. Below is French butterfly tail Breguet Fauvette; note high aspect ratio wing and spoilers.



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WHO'S WHERE

(*Continued from page 23*)

Changes

James R. Weiner, consulting scientist on the staff of the director of research, Lockheed Missiles and Space Division, Sunnyvale.

Roy J. Sandstrom, assistant general manager, Bendix Systems Division, Bendix Aviation Corp., Ann Arbor, Mich.

The following appointments within the Telecommunications Laboratory, Research and Development Division of Space Technology Laboratories, Inc., Los Angeles, Calif., have been announced: **R. G. Stephenson,** senior staff engineer; **Dr. Arnold Rosenbloom,** manager, Computer and Guidance Department; **R. L. Walquist,** manager, Communications and Tracking Department.

Dr. Rudolf Hermann, technical director of hypersonic facilities, University of Minnesota's Rosemount Aeronautical Laboratories, Rosemount, Minn.

Burroughs Corp., Detroit, Mich., has announced the following changes at the corporation's Research Center, which has laboratories in Great Valley and Paoli, Pa.; **Robert V. D. Campbell,** director of research; **Dr. Charles L. Register,** manager, Great Valley Laboratory; **John H. Howard,** manager, Paoli Laboratory.

Matthew H. Portz, National Aeronautics and Space Administration's Western Public Information Officer, Santa Monica, Calif. **Harry J. McDevitt, Jr.,** succeeds Mr. Portz as Information Officer at NASA's Lewis Research Center, Cleveland, Ohio.

F. C. Young, head of Boeing Airplane Co.'s new office in Ogden, Utah, to provide direct representation to USAF's Ogden Air Materiel Area on the Boeing Bomarc and Minuteman programs.

Jack Armstrong, former engineering test pilot for Douglas Aircraft, has formed Blandford-Armstrong & Associates, a consulting firm offering technical assistance to airlines entering jet operations, with offices in Los Angeles, Calif., and Geneva, Switzerland.

Melvin B. Kline, director of research and development, Brubaker Electronics, Inc., a subsidiary of Telecomputing Corp., Culver City, Calif.

Abraham Hertzberg, head of the Aerodynamic Research Department, Cornell Aeronautical Laboratory, Inc., Buffalo, N. Y.

David C. McNeely, manager, Helipot Division of Beckman Instruments, Inc., Fullerton, Calif.

Leigh Brite, manager of Space Electronics, Space Technology Operations, Aeronutronic, a division of Ford Motor Co., Newport Beach, Calif.

John S. Inglis, manager of operations, Frederick B. Ayer & Associates, Inc., New York, N. Y.

Rudi Beichel, project engineer-Saturn space vehicle's second stage rocket engine, Aerojet-General Corp.'s Liquid Rocket Plant, Sacramento, Calif.

John M. Van Dam, general manager, General Logistics Division of Aeroquip Corp., Burbank, Calif.

Fred Heller, assistant general manager, Omaton Division of Burndy Corp., Norwalk, Conn.

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EMPLOYMENT OPPORTUNITIES

NATIONAL COVERAGE

The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual, etc.

Positions Vacant | Civil Service Opportunities | Employment Agencies
Positions Wanted | Selling Opportunities Wanted | Employment Services
Part Time Work | Selling Opportunities Offered | Labor Bureaus

DISPLAYED ——RATES—— **UNDISPLAYED**

The advertising rate is $45.00 per inch for all advertising appearing on other than a contract basis. Frequency rates quoted on request.

An Advertising Inch is measured ⅞" vertically on a column—2 columns—30 inches to a page.

Subject to Agency Commission.

$2.70 per line, minimum 3 lines. To figure advance payment count 5 average words as a line.
Position Wanted Ads are ½ of above rate.
Box Numbers—counts as 1 line.
Discount of 10% if full payment is made in advance for 4 consecutive insertions.
Not subject to Agency Commission.

Send NEW ADS to Classified Advertising Div. of AVIATION WEEK, P. O. Box 12, N. Y. 36, N. Y.

Engineers, EE

Overlooking Field Engineering Because You're Married?

68% of the Field Engineers are Married at General Electric's Light Military Electronics Dept.

▶ Contrary to the notion that bachelor engineers are best suited to Field Engineering, here are the results of a recent study at this General Electric Department:

Married 68.2%

Married with Children 49.7%

Incentives for an Engineer with a Family are many in Field Service at LME Dept:

—First—they like being on their own. (As the only representative for G.E. at your location, you are Mr. G. E.)

—There's the excitement of travel to new places—BUT at not too frequent intervals. (Assignments average 1 year at one location)

—Important, but not most important, is the favorable financial set-up. (We'll be glad to give you the details)

Our current product lines are:

Radar — Countermeasures — Digital Communications — Navigation — Armament Systems — Flight Control — Missile Guidance — Test Equipment

Requirements:

BS in Electrical Engineering or BS in Mechanical Engineering, Physics or Mathematics with minimum of 2 years electronics experience.

• Write today—and by return mail we'll send you a simple application form.

Mr. R. S. ZIEHMN, Rm 64-WG
Light Military Electronics Dept. - Product Service

GENERAL ELECTRIC
831 Broad Street Utica, N. Y.

ADVERTISING MANAGER

One of the country's best-known firms is seeking a veteran advertising manager, who combines creativity and sound judgment, for administration of a division advertising program slanted at Latin America.

Thorough knowledge of both English and Spanish is essential. Industry horizons are unlimited and base location is unsurpassed.

Replies held strictly confidential. Send resume of experience, background, and statement of minimum acceptable salary to

P-2302, Aviation Week
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

AIRLINE REGIONAL SALES EXECUTIVES
AIRLINE DISTRICT SALES EXECUTIVES

A leading international airline is expanding its sales force and require a Sales Manager of outstanding creative ability, as well as a number of area Sales Managers, all of proven success in airline sales work and capable of assuming duties without a formal training period. Thorough knowledge of both English and Spanish is essential.

The Sales Manager will be given the opportunity of increasing sales now amounting to some twenty million dollars annually. Sales Manager candidates will be considered for area jobs if not selected as suitable for the major one.

Salary open to discussion. Replies held strictly confidential. Send resume with background to

P-2303, Aviation Week
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

What is *your* problem?

Competent men for your staff? . . . employment? . . . or are you looking for—or offering—a business opportunity of special interest to readers of this publication? You can get their attention—at small cost—through an advertisement in the Employment Section of AVIATION WEEK.

Once-in-a-career openings for

ENGINEERS

who want

RAPID CAREER ADVANCEMENT

CHALLENGING PROJECTS

ABUNDANT LIVING

Design Engineers
(Airframe and Honeycomb Components)

Stress Analysts

Project Engineers
(Aircraft Ducting)

Project Engineers
(All-metal Honeycomb)

Project Engineers
(Rocket Engine Components)

Development Engineers
(Gas Turbine Controls)

Metallurgists

Reliability Engineers

Solar offers exceptional opportunities right now! Solar is humming with exciting and challenging projects of the Space Age, including a secret ARPA project involving a completely new anti-missile defense system and several significant gas turbine projects. The right men joining now will gain key creative positions in their fields of interest.

SOLAR SPECIFIES

Solar is a medium-size company (2500 people in San Diego) with a successful history since 1927. It is big enough to offer the most advanced personnel policies, yet small enough so you don't get lost in the crowd. Salary and performance reviewed semi-annually. Liberal relocation allowances. The special professional status of engineers is fully appreciated and recognized. A new 60,000 sq. ft. engineering building, necessitated by expanding research and development, will be completed in 1959 on the edge of San Diego Bay. A huge new furnace for heat treating and brazing has just been completed.

IDEAL LOCATION

Solar is located in sunny San Diego with the finest year-around climate in the U.S. Recreational, cultural and educational facilities are superb. The new advanced science branch of the University of California offers exceptional opportunities for further study. Outdoor living and sport can be enjoyed all year long. You and your family will really "live" in San Diego!

SEND RESUME

Please send resume of your qualifications at the earliest opportunity to Louis Klein, Dept. E-423, Solar Aircraft Company, 2200 Pacific Highway, San Diego 12, Calif.

SOLAR
AIRCRAFT COMPANY
SAN DIEGO
DES MOINES

ADDRESS BOX NO. REPLIES TO: Box. No. Classified Adv. Div. of this publication. Send to office nearest you.
NEW YORK 36: P. O. BOX 12
CHICAGO 11: 520 N. Michigan Ave.
SAN FRANCISCO 4: 68 Post St.

POSITIONS VACANT

Wanted Captain DC-4 aircraft, ATR-Instructors—Check Pilot Ratings & Experience Temporary or Permanent Contract. Send full details, resume and experience and salary required, to: Trans Mediterranean Airways. P. O. B. 3018, Beirut, Lebanon. Att: Mr. C. V. Richmond.

Flight Instructors; Age 26-38 with commercial, instructor and instrument ratings. Minimum 2000 hours or military rating. Air Force contract school, many fringe benefits. Personnel Manager, Anderson Air Activities, Malden Air Base, Missouri.

Project Engineers for advanced aerodynamic or propulsion wind tunnel testing. Conduct liaison with test sponsors, develop test plans, direct tests, evaluate data, prepare test reports. Send resume to Technical Employment, ARO, Inc., Tullahoma, Tenn.

Ground Mechanic—experienced man, A & P license, qualified to do overhaul and maintenance on two Twin-Beech aircraft operated by company from Pittsburgh base. Write Buell Whitehill, Jr., Director of Personnel, The Rust Engineering Company, 930 Fort Duquesne Boulevard, Pittsburgh 22, Pennsylvania.

POSITIONS WANTED

ATR Pilot, age 39—11,500 hours, no accidents, domestic and international airline experience. Experienced in light planes, DC-3, C-46, and DC-4, College background, also, Flight Instructor and A&E certificates. Desire permanent flying position. PW-2192 Aviation Week.

Pilot with 7 years of experience in Multiple Engine Jet Operator, 1000 hours jet front seat time including electronic test. Desires employment consistent with experience. Resume on request. Available 30 November 1959. PW-2288, Aviation Week.

Export Executive—7 years aeronautical engineering and technical background. 12 years extensive experience in all phases of aviation export sales organization. Interested in obtaining position with prime aircraft; space vehicle and missiles; avionics; support equipment; or airline and airport equipment manufacturer desiring to initiate or expand operations in international markets. PW-2357, Aviation Week.

Space Salesman. Two aviation magazines—Eastern office. Must have aviation background with pilot experience and advertising space sales record. Salary $10,000. plus. P-2337, Aviation Week.

Naval Aviator—Commercial and instrument—1200 hours total 800 Super Constellation—26—Married, 2 children—College Graduate—Desires flying position with future. PW-2352, Aviation Week.

New "EMPLOYMENT" Advertisements

received by 10 A.M. Aug. 21st will appear in the Aug. 31st issue, subject to space limitations.

AVIATION WEEK
Classified Advertising Division
P. O. BOX 12
NEW YORK 36, N. Y.

A "TIME-TABLE" FOR SPACE CONQUEST

BY **1963** – INSTRUMENTED PLANETARY SOFT LANDING

BY **1968** – SPACE STATION FOR STAGING TO MOON AND PLANETS

BY **1970-75** – MOON BASE

These predictions were made by Alexander Kartveli, Vice-President for Research & Development at Republic Aviation, and one of the most optimistic of the 56 leading space experts of the world who were consulted by the U.S. House of Representatives Committee on Astronautics & Space Exploration for its report: "The Next 10 Years in Space, 1959-1969."

JOIN REPUBLIC IN AN **INTEGRATED ATTACK** ON PROBLEM AREAS OF **SPACE EXPLORATION**

It's the fervent conviction of engineers and scientists at Republic Aviation that the courageous "Space Time-Table" above is entirely feasible – given a tradition-free, integrated approach to the problems. Such an approach is evident at Republic Aviation. Here, groups of specialists from many disciplines are working in close collaboration to solve problems across the entire spectrum of space technologies, which limit today's interplanetary and upper atmosphere flight capabilities.

Expanded by $35,000,000 last year, Republic's integrated Research and Development program has already produced signal advances in space guidance concepts; in new propulsion systems (plasma, nuclear); in radiation physics; in new materials and processing techniques; in unique hypersonic configurations; and in prototype development of hardware (as an example: hydraulic systems that operate reliably up to 1000°F).

Professional men—who can meet new challenges with enthusiasm and dedication – are urged to look into openings with our R&D groups, working in an atmosphere of exhilarating intellectual adventure.

Electronics
Inertial Guidance & Navigation
Digital Computer Development
Systems Engineering
Information Theory
Telemetry-SSB Technique
Doppler Radar • Countermeasures
Radome & Antenna Design
Microwave Circuitry & Components
Receiver & Transmitter Design
Airborne Navigational Systems
Jamming & Anti-Jamming
Miniaturization — Transistorization
Ranging Systems
Propagation Studies
Ground Support Equipment

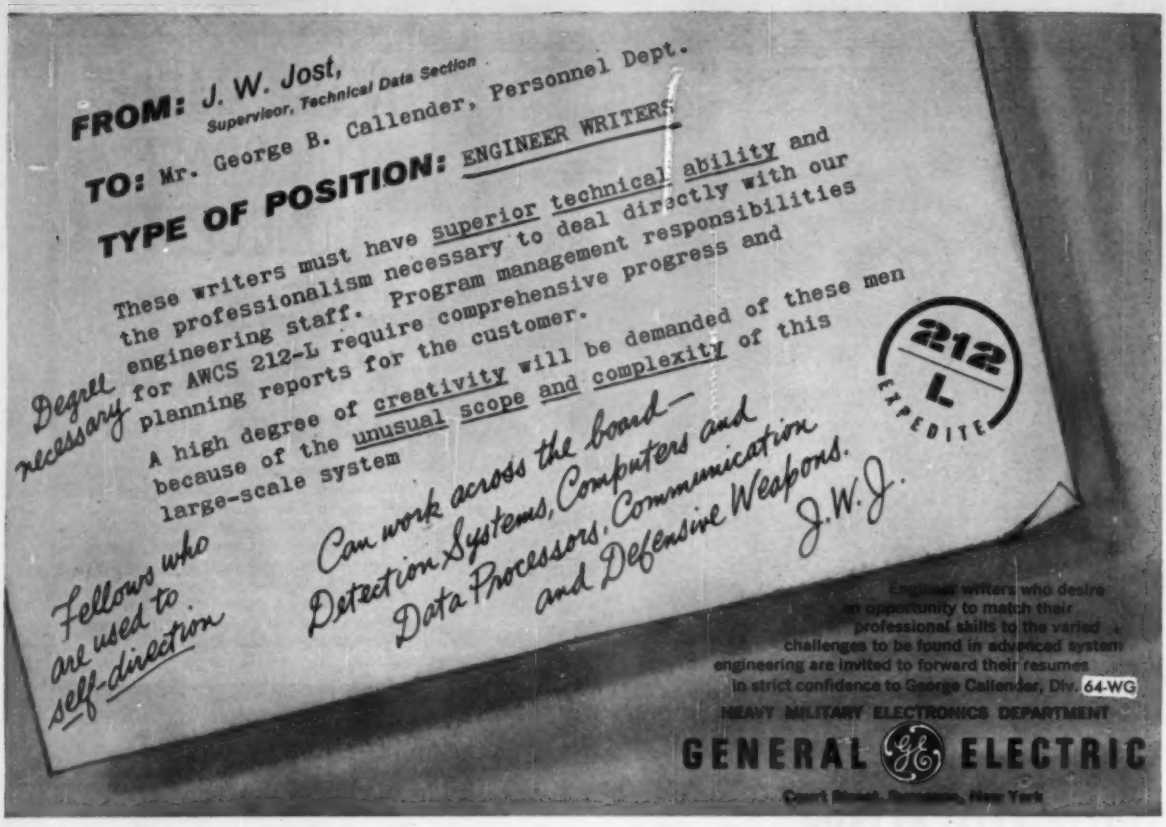
Thermo, Aerodynamics
Theoretical Gasdynamics
Hyper-Velocity Studies
Astronautics Precision Trajectories
Airplane/Missile Performance
Air Load and Aeroelasticity
Stability and Controls
Flutter & Vibration
Vehicle Dynamics & System Designs,
High Altitude Atmosphere Physics
Re-entry Heat Transfer
Hydromagnetics
Ground Support Equipment

Plasma Propulsion
Plasma Physics
Gaseous Electronics
Hypersonics and Shock Phenomena
Hydromagnetics
Physical Chemistry
Combustion and Detonation
Instrumentation
High Power Pulse Electronics

Nuclear Propulsion and Radiation Phenomena
Nuclear Weapons Effects
Radiation Environment in Space
Nuclear Power & Propulsion Applications
Nuclear Radiation Laboratories

Send resume in complete confidence to: Mr. George R. Hickman, Engineering Employment Manager, Dept. IH-4

REPUBLIC AVIATION
Farmingdale, Long Island, New York


FROM: J. W. Jost,
Supervisor, Technical Data Section
TO: Mr. George B. Callender, Personnel Dept.
TYPE OF POSITION: ENGINEER WRITERS
These writers must have superior technical ability and the professionalism necessary to deal directly with our engineering staff. Program management responsibilities
Degree necessary for AWCS 212-L require comprehensive progress and planning reports for the customer.
A high degree of creativity will be demanded of these men because of the unusual scope and complexity of this large-scale system
Fellows who are used to self-direction
Can work across the board—Detection Systems, Computers and Data Processors, Communication and Defensive Weapons.
J.W.J.
212
L
EXPEDITE
Engineer writers who desire an opportunity to match their professional skills to the varied challenges to be found in advanced system engineering are invited to forward their resumes in strict confidence to George Callender, Div. 64-WG
HEAVY MILITARY ELECTRONICS DEPARTMENT
GENERAL ELECTRIC

FOOD SERVICE MANAGER

Attractive opening in Miami, Florida, for food service specialist, combining complete knowledge of food service field with proven managerial ability to administer staff of some 350 persons.

Background in hotels, restaurants, airlines, considered equally. Replies held in confidence. Address resume, stating minimum salary acceptable, with detail of background experience, to

P-2364, Aviation Week
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

GENERAL MANAGER

Nationally known aviation company needs experienced man to manage aircraft distributorship.

Unlimited opportunity for well qualified person with managerial and sales background and experience.

Compensation commiserate with qualifications.

Send complete resume to:

P-2377, Aviation Week
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

AIRCRAFT MAINTENANCE SUPERVISOR

Fast growing, commuter airline has a wonderful opportunity for a line maintenance supervisor. Good working conditions and salary is open based on ability. Must have A/P License. Interested candidates with two or more years maintenance supervisory experience on DC-3 and Convair aircraft, write for interview, giving detailed experience resume to: Southeast Airlines, Personnel Department, P.O. Box 46, Kingsport, Tennessee.

Sales Manager Available

Eighteen years experience—selling accessories to Airframe Missile, Engine, Electronics and Government agencies. Graduate engineer B.S.M.E. Southern Calif. preferred.

P-2348—Aviation Week
.125 W. 6th St., Los Angeles 17, Calif.

To EMPLOYERS Who Advertise for MEN:

Frequently, when there are many applicants for a position, only the most promising letters are acknowledged. The other applicants never know whether their letters reached a prospective employer or not. These men often become discouraged, will not respond to future advertisements and even question their bona fide character.

Every Advertisement Printed in the Searchlight Section Is Duly Authorized.

You can help keep our readers interested and get better returns to your advertising in this section if you acknowledge each reply—in plain envelopes, if you wish.

Classified Advertising Division

McGRAW HILL PUBLISHING CO., INC.

"Put Yourself in his place."

When Answering BOX NUMBERS...

to expedite the handling of your correspondence and avoid confusion, please do not address a single reply to more than one individual box number. Be sure to address separate replies for each advertisement.

"SYSTEM DEVELOPMENT CORPORATION

is currently seeking scientists and engineers in various skill areas. As part of this effort, I have been given the opportunity to tell you something about our organization.

"Let me begin by giving you some general facts about the Corporation: SDC is a non-profit organization chartered to work in fields pertaining to public welfare, the advancement of science, and national defense. The Corporation's name implies its function—the development of systems. Specifically, we are concerned with large, complex information processing systems with a high degree of automation. Development of these systems is accomplished through the application of knowledge in the areas of applied mathematics, engineering, and psychology, to problems of over-all system design, data processing techniques and optimum man-machine relationships.

"Our work is system-oriented, rather than concerned with the design or manufacture of hardware components. As a result of this type of specialization, we have assumed major responsibilities in the development of systems such as the SAGE (Semi-Automatic Ground Environment) Air Defense System and the world-wide Strategic Air Command Control System, and in the integration of the functional responsibilities of these systems with other military electronic support systems.

"Because the scope of our activities is rapidly increasing, we are expanding our staff. In this message I am specifically addressing young engineers with advanced training and proved analytical ability in the areas of weapons system analysis, noise and information theory, ECM, electromagnetic intelligence and allied fields. If you are qualified, and our corporate activities sound interesting to you, we would like to hear from you. Address inquiries regarding our Santa Monica, California facility to Mr. R. W. Frost, 2404 Colorado Avenue, Santa Monica, California. Inquiries regarding our Lodi, New Jersey facility should be addressed to Mr. R. L. Obrey, Box 2651, Grand Central Station, New York 17, N.Y. These gentlemen will see that your letter receives prompt attention and confidential treatment."

David Green

David Green, Assistant Director for Plans,
Operations and Management Research Directorate

SDC

SYSTEM DEVELOPMENT CORPORATION

SANTA MONICA, CALIFORNIA · LODI, NEW JERSEY

ENGINEERS • SCIENTISTS

Seek and find Daring New Goals and Rewards with General Electric's Growing

FLIGHT PROPULSION DIVISION* in Cincinnati

*(*formerly Aircraft Gas Turbine Division, recently renamed to match its expanding product goals)*

Our engineers and scientists enjoy the daily challenge of new and stimulating technical problems in the largest number of advanced propulsion system projects in our history. Men with imagination and ideas are needed as Managers and Specialists in:

MECHANICAL DESIGN
- Jet, rocket powerplants
- Turbofans
- Components
- Stress, vibration
- Heat transfer
- Turbomachinery

THERMODYNAMICS
RELIABILITY ENGINEERING
- Powerplants
- Components
- Mathematical
- Accessory & Control Systems

QUALITY CONTROL
INSTRUMENTATION DEVELOPMENT
METALLURGICAL ENGINEERING

Advancement opportunities are multiplied—nearly 50% of our professional people earn promotion every year. Our engineering staff has more than doubled since 1955.

● *LOOK INTO NEW POSITIONS NOW OPEN IN OUR 4 DEPARTMENTS IN CINCINNATI for Graduate Engineers & Scientists.*

(Some positions available to well qualified non-citizens.)

For further information on the opportunities that will let you use your talents better, send your resume to Dr. Mark Elwood, Bldg. 100, Dept. 69-WG.

FLIGHT PROPULSION DIVISION

GENERAL ELECTRIC

Cincinnati, Ohio

Jet Engine Control Engineers: See our ad on following page.

Achievement in Action at **Avco** *. . . for*

SCIENTISTS AND ENGINEERS

Achievement is habit at Avco! A leader in the field of atmospheric re-entry, Avco is now providing significant contributions to basic and applied research in Space and Missile Technology.

Supervisory, Senior and Junior positions are available in these areas:

- **ELECTRONICS**
- **MATHEMATICS**
- **PHYSICS AND CHEMISTRY**
- **COMMUNICATIONS**
- **MATERIALS**
- **FLIGHT TEST ENGINEERING**
- **DESIGN ENGINEERING**
- **PRODUCT ENGINEERING**
- **AERODYNAMICS**
- **APPLIED MECHANICS**
- **THERMODYNAMICS AND HEAT TRANSFER**

Attractive working environment outside of metropolitan Boston. The large, fully equipped, modern laboratory is close to Boston educational institutions and cultural events. The division offers a liberal educational assistance program for advanced study.

Forward your inquiry to:
Mr. Richard Rubino
Manager, Personnel Relations
Dept. AW-8

AVCO
Research & Advanced Development
201 Lowell St., Wilmington, Mass.

FOR RATES OR INFORMATION

About Classified Advertising

Contact The McGraw-Hill Office Nearest You

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1301 Rhodes-Haverty Bldg.
JAckson 3-6951
R. H. POWELL

BOSTON, 16
350 Park Square
HUbbard 2-7160
D. J. CASSIDY

CHICAGO, 11
520 No. Michigan Ave.
MOhawk 4-5800
W. J. HIGGENS - E. S. MOORE

CLEVELAND, 13
55 Public Square
SUperior 1-7000
W. B. SULLIVAN - T. H. HUNTER

DALLAS, 2
1712 Commerce St.,
Vaughan Bldg.
Riverside 7-5117
GORDON JONES - F. E. HOLLAND

DETROIT, 26
856 Penobscot Bldg.
WOodward 2-1793
J. R. PIERCE

LOS ANGELES, 17
1125 W. 6 St.
HUntley 2-5450
P. M. BUTTS

NEW YORK, 36
500 Fifth Ave.
OXford 5-5959
H. T. BUCHANAN - R. P. LAWLESS
T. W. BENDER

PHILADELPHIA, 3
17th & Sansom St.
RIttenhouse 6-0670
H. W. BOZARTH - T. W. McCLURE

ST. LOUIS, 8
3615 Olive St.
JEfferson 5-4867

SAN FRANCISCO, 4
68 Post St.
DOuglas 2-4600
S. HUBBARD

ENGINEERS & SCIENTISTS

FOR

RESEARCH PROGRAMS

IN

IONOSPHERIC PROPAGATION & HF COMMUNICATIONS

Our accelerated growth in these fields offers attractive opportunities to join senior engineers and scientists of stature now involved in challenging, advanced projects. Responsible assignments furthering the state-of-the-art in these fields, plus competitive salaries and outstanding growth potential are offered to men who can contribute to the progress of these important programs.

SENIOR IONOSPHERIC PHYSICIST

Ph.D preferred plus several years experience in the study of ionospheric phenomena. Should be familiar with present knowledge of upper atmosphere physics and possess an understanding of current programs using rockets and satellites for studies in F-region and beyond. Qualified man with supervisory abilities will have an exceptional opportunity to assume project leadership duties on an HF project already under way involving F-layer propagation studies backed by a substantial experimental program.

SENIOR ELECTRONIC SCIENTIST

Advanced degree in E.E. or Physics preferred. Must be familiar with present state-of-the-art in the design of advanced HF receivers and transmitters, and possess working knowledge of modern HF networks employing ferrites and metallic tape cores. Strong theoretical background in modern linear circuit theory desired. Will carry out laboratory development implementation of new HF communication systems.

STAFF ELECTRONIC ENGINEERS (RADAR)

Advanced degree in E.E. preferred. Must be familiar with conventional pulse circuit designs and applications. Technical background should include substantial experience in data process and data recovery systems using both analog and digital techniques. Knowledge of principles and application of modern information theory including correlation techniques helpful. Will be responsible for the design of subsystems.

GLOBAL COMMUNICATIONS SPECIALISTS

BS degree plus 5 to 10 years' experience embracing theoretical as well as practical knowledge of communications systems design involving F-layer ionospheric propagation techniques. Working knowledge of modern high-power HF transmitters and HF receiving systems.

DEVELOPMENT ENGINEER

Advanced degree in M.E. or physics preferred. Must be skilled in advanced laboratory techniques in rocket motor development. Strong background in applied thermodynamics, aeroballistics and rocket propulsion desired. This is a new project in planning stage. Opening requires person capable of assuming duties of assistant project manager.

EXCELLENT SALARIES
Commensurate with education & experience

MODERN COMPANY BENEFITS
including educational assistance plan

RELOCATION ASSISTANCE

Ideal Living Conditions in Suburban Washington D. C. Expense-Paid Interviews with Selected Applicants.

Send resume Stating Education & Experience to:
Mr. R. J. REID, Technical Employment Manager

RESEARCH & DEVELOPMENT GROUP
NUCLEAR PRODUCTS—ERCO
DIVISION OF ACF INDUSTRIES INCORPORATED
Riverdale, Maryland Warfield 7-4444

JET ENGINE CONTROL ENGINEERS

ALTITUDE: 70,000 Ft.
SPEED: Mach 3+

These parameters demonstrate why new approaches are required to design and develop jet engine controls at the Flight Propulsion Division of General Electric

New and maturing engine programs here have created a number of opportunities for men who can assume responsibility for the *full scope* of design effort on a project basis. This carries through to design modifications in the production model, and may incorporate novel application of magnetic amplifiers, transducers, torque motors, servo-motors and transistors.

Typical of the broad programs where engineers with previous jet engine control experience can apply their creativity are:

J79 • TF35 • J93 • CJ-805-3 • CJ-805-23

and other classified projects of unusual interest with *both* military and commercial applications.

FRIENDLY CINCINNATI

FPD's Cincinnati location affords a wealth of living and professional advantages, including fine schools, plentiful housing, over 30 active engineering societies, many cultural groups, and opportunity for advancing your professional education.

If you hold an EE, ME or AE degree and have at least 2 years jet engine control design and development experience, send your resume now to:

Dr. Mark Elwood, Bldg. 100, Dept. 64-WG8
FLIGHT PROPULSION DIVISION
GENERAL ELECTRIC
Cincinnati 15, Ohio

For other openings at FPD see our ad on preceding page.

CLASSIFIED

SEARCHLIGHT SECTION

ADVERTISING

BUSINESS OPPORTUNITIES — EQUIPMENT - USED or RESALE

DISPLAYED RATE:

The advertising rate is $31.00 per inch for all advertising appearing on other than on contract basis. Contract rates on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page.

EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

UNDISPLAYED RATE:

$2.70 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.

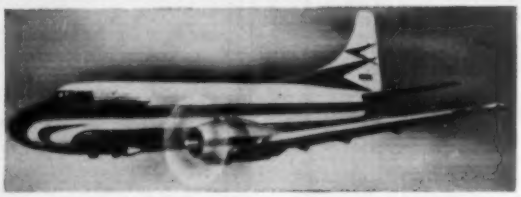
PROPOSALS, $2.70 a line an insertion.

BOX NUMBERS count as one line additional in undisplayed ads.

Send NEW Ads or Inquiries to Classified Adv. Div. of Aviation Week, P. O. Box 12, N. Y. 36, N. Y.

Pressurized and Refrigerated

MARTIN 404 FOR EXECUTIVE CONVERSION



Airplane stressed for turbo prop's. Low time 2800-CB-16/17 engines. Airplane Low time since base overhaul. Ground and flight refrigeration. Short field T.O. and ldg. capabilities. Quietest twin-engine aflight. Boost controls. Complete airline radio. Integral loading ramp. Dual windows. Total gas load: 1370 gals. Gross Wt.: #44,900: empty. #27,790. Trades accepted.

CALIFORNIA AIRMOTIVE SALES CORP. Dept. AW.

7139 Vineland Ave., North Hollywood, Calif., U.S.A.
Phones: POplar 5-6202 TRiangle 7-1564 Cable: CALMOTI
AIRPORT FACILITIES, Hangar No. 2, Lockheed Air Terminal, Burbank, Calif.

FOR SALE
SPECIALTY & CONTOUR
JOB MACHINE SHOP

A going company available for immediate production. Includes land, modern building and fully equipped machine shop. Skilled workmen now on payroll. Located in midwest city. Approximately three acres of land. Building 18,000 square feet. Room for parking and expansion. Precision machinery in excellent condition. Office air conditioned. Price complete $375,000. Address inquiry to

Box FS-2347—Aviation Week
520 N. Michigan Ave., Chicago 11, Ill.

FOR SALE
IMMEDIATE DELIVERY
North American
AT-6's—T-28's—B-25's

Douglas	Boeing	Twin Beech
B-26's	**B-17-G's**	**C-45-H's**

THOMPSON AIRCRAFT SALES
2626 E. Washington St., Phoenix, Arizona
Phones BR 5-5479 or 5-9297
"World's Largest Dealers In Surplus Military Aircraft"

WHERE TO BUY

Featuring additional products, specialties & services for the aviation field

---

FOR LEASE

DC-6

91 seat interior. Low time. Available early September. Now in scheduled airline service.

DC-3 with 28 seat interior available September 15.

NATIONAL AERO LEASING CORP.
P. O. Box 48-184 Newton 5-0734 Miami, Fla.

WANTED DC-3

Corporation wants executive DC-3. Send complete details. Principals only.

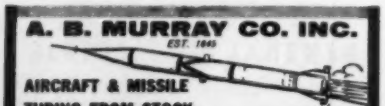
Box W-2305, Aviation Week
Class. Adv. Div., P.O. Box 12,
N.Y. 36, N.Y.

When Answering

BOX NUMBERS...

to expedite the handling of your correspondence and avoid confusion, please do not address a single reply to more than one individual box number. Be sure to address separate replies for each advertisement.

A. B. MURRAY CO. INC.
EST. 1845



AIRCRAFT & MISSILE TUBING FROM STOCK
Elisabeth, N. J. • Bristol, Pa. • McK...

C46A CARGO AIRCRAFT
AVAILABLE
Low time since new.
Ready for cargo or passenger conversion.
CALL — WRITE — WIRE
— FOR DETAILS —

AAXICO AIRLINES P.O. Box 48-875
Miami, Florida Tuxedo 7-1541

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LETTERS

Accident Analysis

Permit me to refer to the letters entitled "Copilot Cancels" and "Seeking Truth" which appeared in your June 15 (p. 118) and July 6 (p. 138) issues.

These letters mention, along with other matters, that the engine which failed and caught fire in the Braniff Airways accident at Miami, Fla., on Mar. 25, 1958, was feathered by an Eastern Air Lines captain about one week prior thereto. There appears to be an implication that the log book may have been altered to eliminate this entry and the investigation by the Board may not have disclosed this failure with the consequence that it was not considered in our analysis of the accident.

Exhibit No. D-9, Docket SA-330, shows that the feathering referred to was on Mar. 9. Inspection by Eastern Air Lines revealed the feathering was occasioned by a failure of the No. 10 piston. Since this failure had not contaminated the engine, corrective action consisted of replacing the cylinder and piston assembly. This is an accepted practice in the industry.

Full consideration was given this occurrence and any possible bearing it may have had on the subsequent engine failure and accident. It was concluded that there was no relationship and, as with many other items that are considered and eliminated, it was not discussed in the Board's accident report.

William Kloepfer, Jr.
Chief, Office of Information
Civil Aeronautics Board
Washington, D. C.

Jet-Age Problems

With due respect to Mr. Baggott (AW July 20, p. 114), ownership of a lightplane or some 1,000-odd hours in one doesn't really qualify anyone to become a "soothsayer" and resolve the very real problems that face the air transport industry today.

The many problems of the jet age now upon us have sorely vexed the minds of really intelligent men who are sincerely interested in their solution.

As to Mr. Baggott's remarks about the Air Line Pilots Assn., its rank and file (composed largely of $25,000-per-year glorified chauffeurs), or its president—these remarks are an amazing application of misinformation closely coupled with an appalling lack of facts or first-hand information. It is a well-known and accepted fact in the industry that ALPA has been instrumental in resolving many problems directly concerned with safety in the past.

The average airline pilot today is extremely aware of the ever increasing need for implementing additional safety measures as the nation's air transport fleet increases in size, speed and number. We are also becoming increasingly aware of passenger comfort and well-being. Mr. Baggott's reference to airline pilots, resplendent in their blue and gold uniforms going back to the cabin to allow the "unwashed" to fawn upon them, was very likely the result of an airline pilot trying to ease the tensions of an elderly traveler embarking on a first flight.

As for the 12 hr. kidney retention test that Mr. Baggott makes indirect reference to, it is not yet a part of the airline pilot's bi-annual physical. But the way things are progressing, who knows?

One thing I'm sure all transport pilots will agree on is Mr. Baggott's statement that, ". . . . it is a long step from flying 450 hp. to getting into a jet airplane . . ."

Leon Lipsky
Airline Pilot
Dallas, Tex.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Business Pilots

I have followed with genuine interest the series of brickbats and compliments on "Rewards and Responsibility" (AW Feb. 16). Representing the business aviation segment of the industry, I am probably pretty critical of the airline segment. However, I think a little moderation on all sides is necessary.

Let's all admit that there are incompetent pilots among us. I wish we could say that all business pilots are on the ball, but we can't. I spent some time in the right seat in the airlines and I can't say that they're all sharp, either. Having spent some time in the Army Air Force during the war, I can't say that all the military are sharp pilots. That does not mean that any of us should condone their actions or try to protect them. I wish we could make every business pilot take a proficiency check every six months, as many of us do, and that we could force them to use correct procedures and fly "by the book."

After quite a bit of flying time in the Air Force, I had to learn a lot from the airlines. I feel that I could not competently execute my many duties in running a "one man airline" without the experience I gained from the airlines. (Note the large number of business pilots who are former airline pilots.) You can learn a great deal riding in the right seat of any plane, particularly an airliner. You learn that airline pilots are not supermen, but ordinary fellows, good and mediocre, fair to good in flying ability, pleasant dispositions and sour, but generally fine fellows trying to do a good job.

You have had some discussion of salaries paid airline pilots. My first thought was that airline salaries are too high. Then I analyzed my thinking and found that I probably think they're too high because business flying is not paying the salaries it should. Most of us are hauling high-priced executives of large and prosperous companies for one-third to one-half the pay that an airline pilot gets. We fly in many cases off airways, often land without ILS and other ground aids, do not have our own network of communication, no company weather system, no dispatcher, no station agent to take care of passengers, no company mechanic to meet us and work off the squawks. All these are our responsibilities, in addition to a safe business-like operation. (I guess it's our own fault we don't have an ALPA to fight for us, although I can't condone some ALPA thinking.) So maybe their salaries aren't too high for the responsibilities they have, ours are too low.

As one of your readers has pointed out, a little self criticism and humility will go a long way in solving all our problems. In a business as serious as ours, we need to weed out the incompetent and irresponsible pilot regardless of where he's flying.

May I add that I feel you have proved that you have a sound editorial policy in printing both sides of this controversy. You have a well-written and factual magazine.

Dick Powell
Chief Pilot
BJ Service, Inc.
Fort Worth, Tex.

Iowa Congressman

As a resident of the State of Iowa, I am writing an apology for the irresponsible contribution of a certain Iowa congressman to the crippling of the nation's space program. Your editorial comments (AW July 20, p. 21) were pungently relevant. I wonder if the same gentleman would be so punctilious in the handling of a multibillion dollar farm subsidy bill.

At any rate, I want to disassociate myself and other progressive citizens of this state from the picayune fiscal sniping of this congressman from Iowa. His pettifogging, awkward, and often absurd criticisims of both Republican and Democratic administrations have ofttimes amused us and sometimes distressed us. He apparently represents a quaint backwater of political opinion which holds that any activity of a strong federal government is suspect and automatically deserving of censure, and which believes that the internal threats of foreign subversion and "Big Spending" are ever so much more dangerous than the external threat of a militant and technologically potent Soviet Union.

I'm sorry I can't do anything about this congressman; he does not represent the Des Moines area.

It's a pity that, at a time when some Iowans are diligently promoting the settlement of modern industries in this industry-poor state, one of our native sons thus exposes us to ridicule.

I hope my remarks adequately express our embarrassment, and help to correct any wrong impression that we are just a bunch of straw-chewing rubes.

Stanley L. Stevens
Des Moines, Iowa

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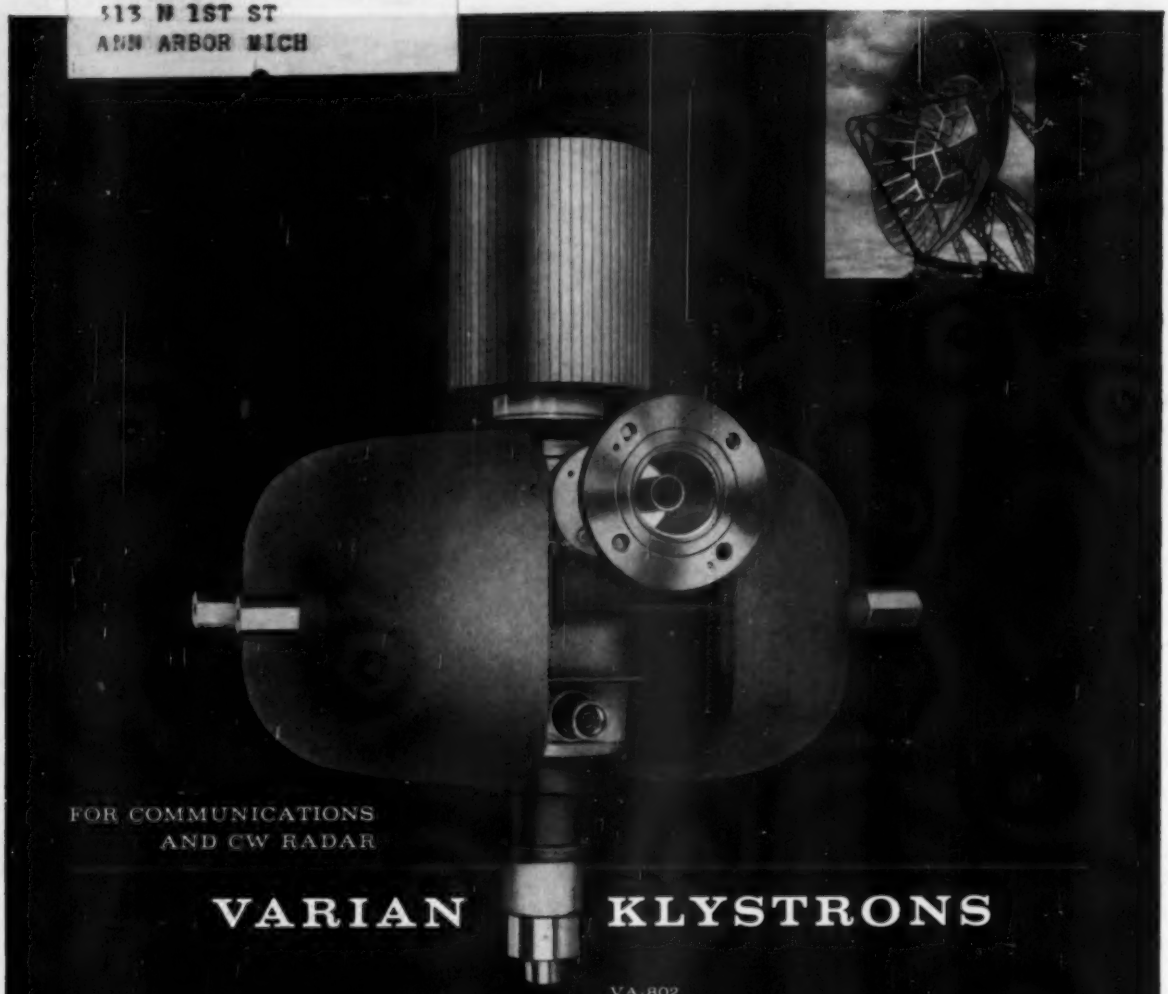

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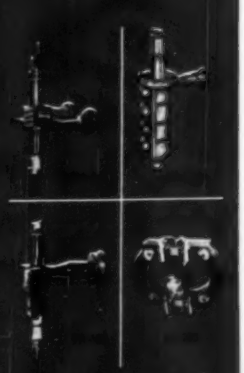
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